Good for the Environment, Good for Business: Foreign Acquisitions and Energy Intensity

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Motivation

- FDI is widely perceived as a source of growth and development
    - Foreign ownership leads to more sales, higher TFP and more innovation
    - Arnold & Javorcik (JIE 2009), Guadalupe et al. (AER 2012)

- But what about its impact on natural environment?

Anecdotal evidence is mixed

- Foreign-owned textile firms dumping pollution in Citarum River, Bandung, Indonesia

- Haze crisis resulting from increased palm oil production in Indonesia

Anecdotal evidence is mixed

- Resource Conservation
  - PepsiCo initiated **energy conservation programs** that have saved more than 4.6 mn kWh of electricity since their inception
  - Baxter International installed **energy-saving lighting systems** in 59 of its 97 worldwide sites by 1996, saving 30-40% of the energy used five years earlier
- Collaboration with external stakeholders on environmental improvement projects.
  - Goodyear helps design community-based **recycling programs**
  - Texaco provides managers and staff to **train employees** of Caltex Pacific in Indonesia in sound environmental practices.
- Internally-oriented Social Responsibility Practices
  - MNCs certify their environmental management systems into **ISO 14001** guidelines. e.g. Sony Corporation (1998), ABB (1997), and Goodyear (1997).
  - Unilever companies have **environmental certification programs for their suppliers**

This paper

Examines the impact of foreign acquisitions on **plant-level energy intensity** and CO_2 **emissions** associated with energy use

Why would we expect foreign affiliates to be more energy efficient?

- Larger scale of production => more worthwhile to incur the cost of energy saving investment
- Access to better technologies
- Better management
- Reputational reasons
- Requirements of export markets

Preview of the results

- Foreign acquisitions **increase production volume**, which in turn **increases energy use and emissions**
- But they **reduce energy and CO_2 emission intensities**
- FDI contributes to **aggregate improvements** in energy efficiency

Outline

- Data
- Empirical strategy
- Foreign acquisitions
- Digging deeper
- Foreign divestments
- Are these effects visible at the aggregate level?

Data

Focus on Indonesia, 1983-2001

- Large FDI inflows from the early 1980s to the late 1990s
- No significant environmental policies implemented during that time

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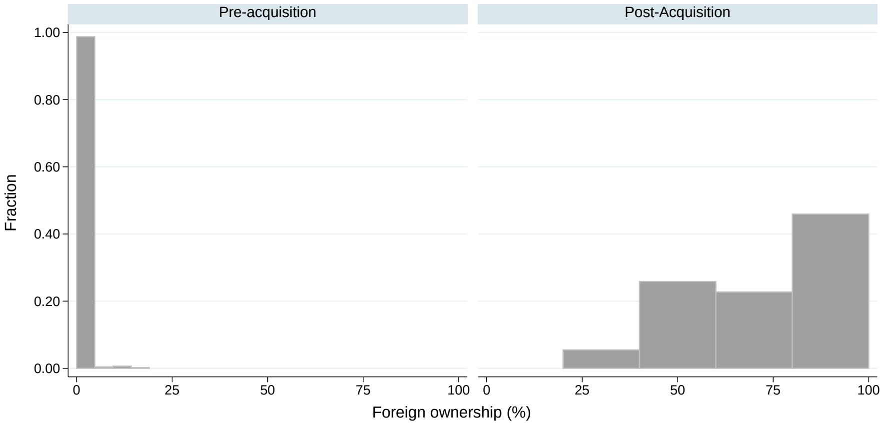
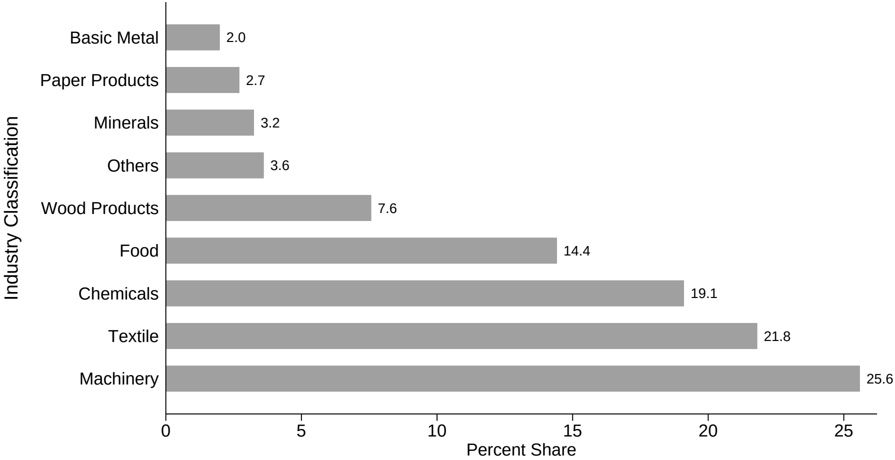
Data: Indonesian Census of Manufacturing

- Includes manufacturing plants with 20 or more employees
- Detailed information on **energy inputs**, both **in terms of expenditure** and **physical units**
- More than 300,000 plant-year observations for more than 40,000 plants
- Foreign acquisition defined as the change in foreign equity share to over 20%

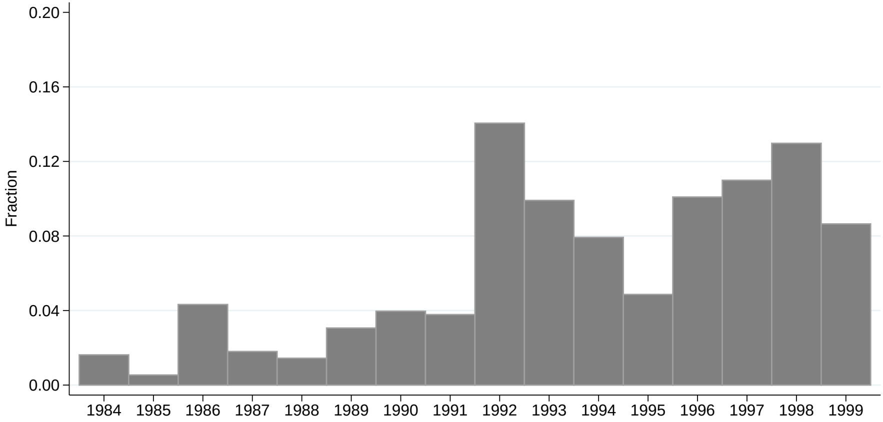
Distribution of foreign equity pre- and post-acquisition



Distribution of foreign acquisitions by industry



Distribution of foreign acquisitions by year



Energy inputs and conversion metrics

Input	Conversion Factor	Source
	Conversion to Energy (in MBTUs)	
Gasoline	1 barrel = 5.600 MBTUs	Silverman, D.; University of California, Irvine)
Diesel	1 barrel = 5.825 MBTUs	US Energy Information Administration (EIA)
Fuel Oil/ Bunker Oil	1 barrel $\approx$ 6.287 MTBUs	EIA
Kerosene	1 barrel = 5.670 MBTUs	EIA
Lubricants	1 barrel = 6.065 MBTUs	EIA
Coal	1 short ton = 21.090 MBTUs	EIA (average between sub- to bituminous coal)
Coke	1 short ton = 24.800 MBTUs	EIA
Public Gas	1 $ft^3 \approx$ 0.001 MBTUs	US Bureau of Mines
Liquefied Petroleum Gas	1 barrel = 3.861 MBTUs	US Environmental Protection Agency (EPA)
Firewood	1 cord = 20 MBTUs	Silverman, D.; University of California, Irvine
Charcoal	1 lb = 0.128 MBTUs	Oak Ridge National Laboratory
Electricity	1 kWh $\approx$ 0.101 MBTUs	EIA (assumes coal-fired generation)
	Conversion to Carbon Dioxide (in kgCO_2)	
Gasoline	1 MBTU = 71.26 kgCO_2	EIA
Diesel	1 MBTU = 71.80 kgCO_2	EPA
Fuel Oil/ Bunker Oil	1 MBTU = 78.80 kgCO_2	EPA
Kerosene	1 MBTU = 72.31 kgCO_2	EPA
Lubricants	1 MBTU = 74.20 kgCO_2	EIA
Coal	1 MBTU = 95.25 kgCO_2	EIA
Coke	1 MBTU = 114.10 kgCO_2	EIA
Public Gas	1 MBTU = 53.06 kgCO_2	EIA
Liquefied Petroleum Gas	1 MBTU = 62.28 kgCO_2	EIA
Firewood	1 MBTU $\approx$ 96.62 kgCO_2	Partnership for Policy Integrity

Empirical strategy

Within-plant output and energy use changes

- One-to-one Propensity Score Matching based on pre-acquisition characteristics
- Matching within year-industry (4-digit) groupings
- Differences-in-differences on matched pairs

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

where i denotes plant and t is the year. We consider two periods, i.e., $t = T-1,\ T+s$ where T is the acquisition year and s =0,1,2. A separate model is estimated for each s.

Balancing test

Variables	Matched sample (210 treated vs 210 controls)		
	Treated	Control	p-value
Used in matching			
Log (Real output)t-1	9.89	9.88	0.951
Log (Energy expenditure/output)t-1	-3.87	-3.83	0.752
Log (Real output)t-2	9.74	9.74	0.997
Log (Energy expenditure/output)t-2	-3.93	-3.86	0.574

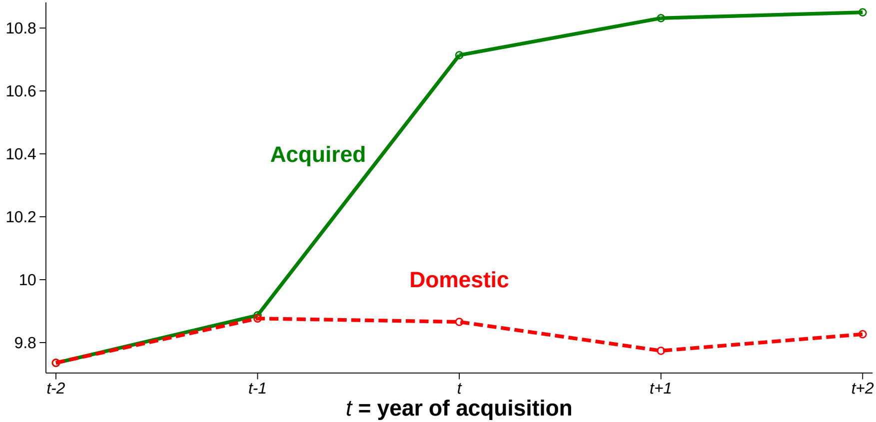
Balancing test

Variables	Matched sample (210 treated vs 210 controls)		
	Treated	Control	p-value
Unused in matching			
Log (Energy expenditure)t-1	6.02	6.04	0.868
Log(Energy use)t-1	8.95	9.00	0.779
Log (CO2 emissions)t-1	13.33	13.38	0.760
Log (Employment)t-1	5.18	5.29	0.338
Exporter dummy t-1	0.19	0.18	0.706
Share of imported materials t-1	0.26	0.19	0.050
Share of skilled workers t-1	0.24	0.22	0.291
Log(Investment in machinery)t-1	8.19	7.80	0.105
Log(Energy use/output)t-1	-0.94	-0.87	0.645
Log(CO2 emissions/output)t-1	3.44	3.50	0.612
Log(Energy exp./materials exp.)t-1	-2.87	-3.07	0.201
Delta Log (Real output)t-1	0.15	0.14	0.893
Delta Log (Energy expenditure)t-1	0.21	0.17	0.644
Delta Log (Energy use)t-1	0.22	0.20	0.887
Delta Log (CO2 emissions)t-1	0.21	0.20	0.857
Delta Log (Energy expenditure/output)t-1	0.06	0.03	0.684
Delta Log(Energy use/output)t-1	0.06	0.06	0.975
Delta Log(CO2 emissions/output)t-1	0.06	0.05	0.938
Delta Log(Energy exp./materials exp.)t-1	0.02	0.04	0.842

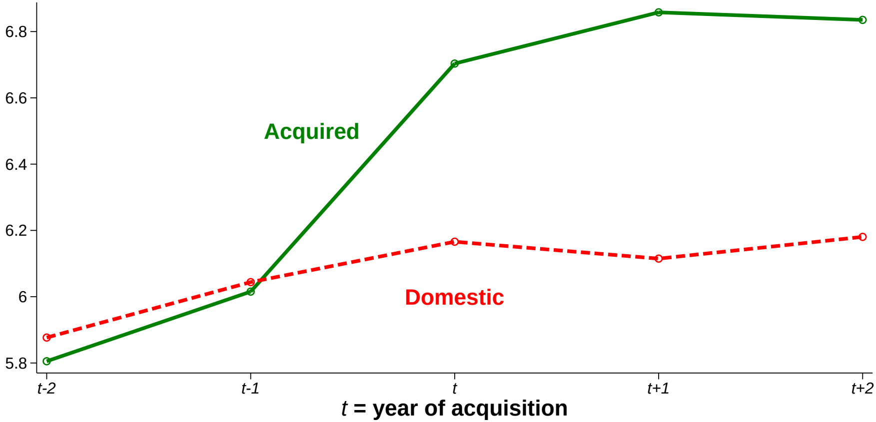
Full Balancing

Foreign acquisition increase the production scale and hence the total energy use and CO_2 emissions

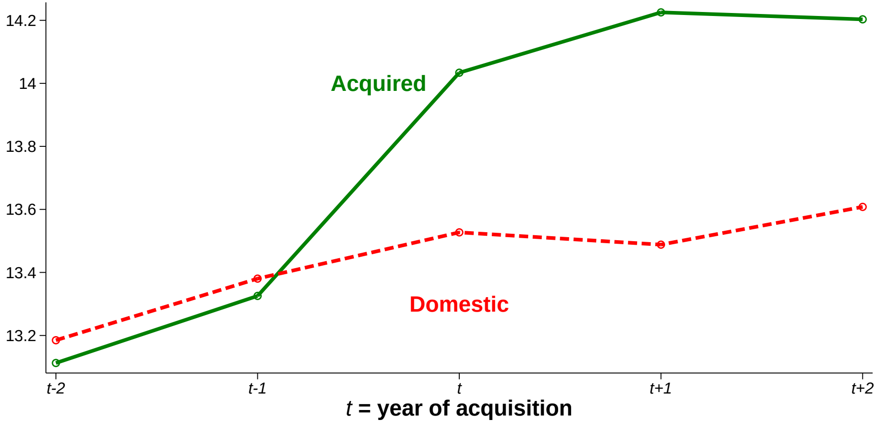
Output


10.8
10.6
10.4
10.2
10
9.8
Acquired
Domestic
t-2
t-1
t
t+1
t+2
t = year of acquisition

Energy Expenditure



CO_2 Emissions

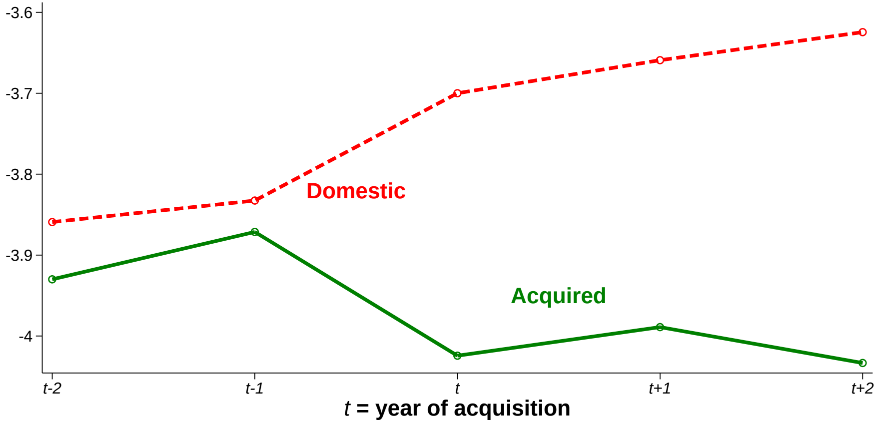


PSM-DID on matched sample: Output, Energy Use and Emissions

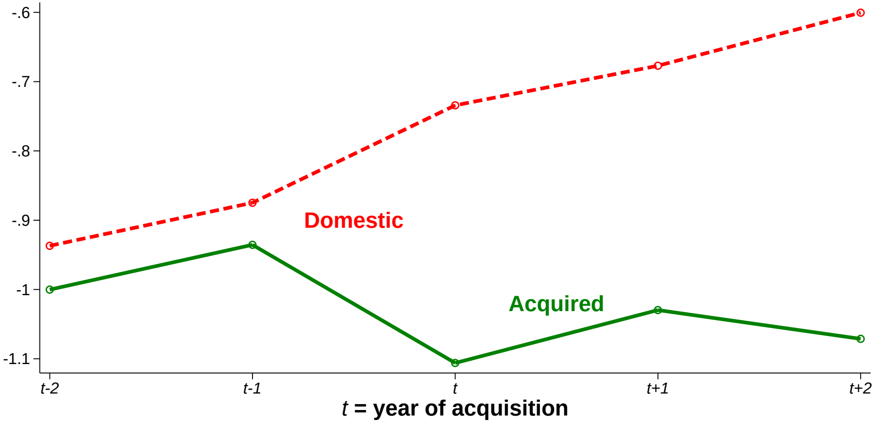
	Acquisition Year	1 Year Later	2 Years Later
		Log(Output)	
Post*Acquired	**0.838*** **	**1.047*** **	**1.013*** **
	(0.113)	**(0.117)**	**(0.122)**
R-sq. (within)	0.203	0.240	0.229
No. of Obs.	840	840	840
		Log (Energy Expenditure in Rps)	
Post*Acquired	**0.567*** **	**0.773*** **	**0.705*** **
	(0.118)	**(0.126)**	**(0.132)**
R-sq. (within)	0.145	0.178	0.163
No. of Obs.	838	838	835
		Log(Energy Use in MBTUs)	
Post*Acquired	**0.539*** **	**0.770*** **	**0.664*** **
	(0.118)	**(0.130)**	**(0.136)**
R-sq. (within)	0.138	0.178	0.168
No. of Obs.	838	838	835
		Log (CO_2 Emissions)	
Post*Acquired	**0.562*** **	**0.792*** **	**0.673*** **
	(0.120)	**(0.130)**	**(0.137)**
R-sq. (within)	0.150	0.188	0.176
No. of Obs.	838	838	835

Foreign acquisition decrease energy and emission intensity

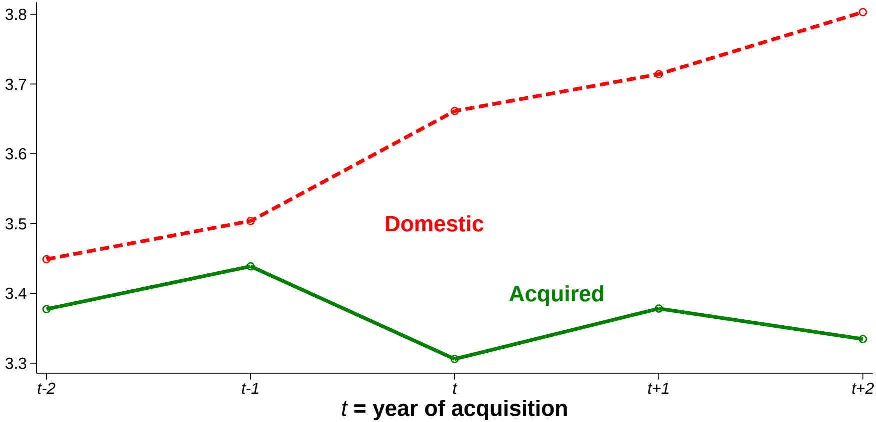
Average Energy Expenditure/Output



Average Energy Use (MBTUs) / Output



Average CO_2 Emissions / Output



Energy and Emission Intensities

	Acquisition Year	1 Year Later	2 Years Later
	Log (Energy Expenditure/Output)		
Post*Acquired	**-0.276****	**-0.282****	**-0.326****
	(0.119)	**(0.118)**	**(0.127)**
R-sq. (within)	0.013	0.014	0.016
No. of Obs.	838	838	835
	Log (Energy Use/Output)		
Post*Acquired	**-0.304****	**-0.285****	**-0.367*****
	(0.120)	**(0.125)**	**(0.137)**
R-sq. (within)	0.015	0.014	0.019
No. of Obs.	838	838	835
	Log (CO_2 Emissions/Output)		
Post*Acquired	**-0.282****	**-0.262****	**-0.357*****
	(0.119)	**(0.124)**	**(0.136)**
R-sq. (within)	0.014	0.015	0.021
No. of Obs.	838	838	835

Robustness checks

Excluding the effect of potential local competition

- matching outside the county (*Kabupaten*) ⏩ Results

Removing the effect of potential changes in markups

- Energy and emission intensity defined relative to material expenditure ⏩ Results

Excluding the 1997-1998 Financial Crisis

- Dropping years beyond 1997 ⏩ Results

Longer Time Horizon

- Extending to 5 years after acquisition ⏩ Results

Different Matching Procedures

- Coursened Exact Matching ⏩ Balancing ⏩ Results
- Inverse Probability Weights ⏩ Balancing ⏩ Results

Evidence of reallocation across energy sources

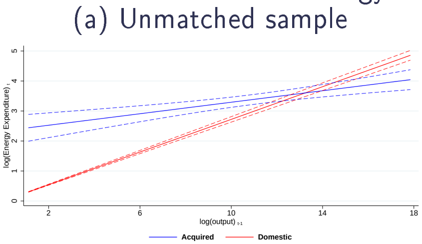
Reallocation across energy sources

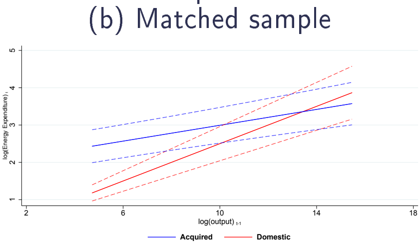
	Acquisition Year	1 Year Later	2 Years Later
	Log(Total fuel expenditure, in MBTUs)		
Post*Acquired	**0.343****	**0.513*****	**0.547*****
	(0.165)	**(0.173)**	**(0.189)**
R-sq. (within)	0.028	0.045	0.045
No. of Obs.	812	815	806
	Log(Electricity expenditure, in MBTUs)		
Post*Acquired	**0.781*****	**0.818*****	**0.679*****
	(0.201)	**(0.208)**	**(0.219)**
R-sq. (within)	0.099	0.137	0.142
No. of Obs.	714	713	711
	Log(Total fuel use/Output)		
Post*Acquired	**-0.471*****	**-0.535*****	**-0.428****
	(0.164)	**(0.171)**	**(0.182)**
R-sq. (within)	0.026	0.027	0.017
No. of Obs.	812	815	806
	Log(Electricity use/Output)		
Post*Acquired	-0.083	-0.300	**-0.406***
	(0.201)	(0.204)	**(0.219)**
R-sq. (within)	-0.001	0.015	0.025
No. of Obs.	714	713	711

Is it all about scale?

Energy intensity vs Scale

Predicted energy expenditure and output





Regression Table: Scale

Evidence of structural change

	Acquisition Year	1 Year Later	2 Years Later
	Log(Capital-Labor ratio)		
Post*Acquired	**0.349****	**0.406****	**0.449****
	(0.145)	**(0.174)**	**(0.201)**
R-sq. (within)	0.034	0.030	0.030
No. of Obs.	658	644	627
	Log(Investment in machinery)		
Post*Acquired	**0.745*****	**0.729*****	**0.861*****
	(0.178)	**(0.202)**	**(0.245)**
R-sq. (within)	0.087	0.070	0.067
No. of Obs.	650	637	620

Is it all about changes to the product mix?

Plants with little change in the product mix

Log (Energy Expenditure/Output)			
	Acquisition Year	1 Year Later	2 Years Later
Post*Acquired	**-0.548****	**-0.528***	**-0.442***
	(0.276)	(0.285)	(0.254)
R-sq. (within)	0.036	0.033	0.035
No. of Obs	222	222	222
	Acquisition Year	1 Year Later	2 Years Later
Post*Acquired	**-1.854*****	**-1.727****	**-1.503****
	(0.676)	(0.718)	(0.680)
Post*Acquired*log(Predicted energy intensity$_{t-1}$)	0.023*	0.021	0.019
	(0.013)	(0.013)	(0.012)
R-sq. (within)	0.072	0.061	0.062
No. of Obs	222	222	222

Plants with little change in the product mix

Log (Energy Expenditure/Output)			
	Acquisition Year	1 Year Later	2 Years Later
Post*Acquired	**-1.590****	**-1.465****	-1.116
	(0.705)	(0.729)	(0.699)
Post*Acquired*log(Predicted energy intensity$_{t-1}$)	0.019	0.018	0.014
	(0.013)	(0.013)	(0.012)
Log (Output)	-0.205	-0.179	-0.221
	(0.163)	(0.153)	(0.148)
R-sq. (within)	0.103	0.084	0.105
No. of Obs	222	222	222
	All years	All years	ll years
Post*Acquired	-0.078	**-1.694****	**-1.516****
	(0.258)	(0.670)	(0.665)
Post*Acquired*log(Predicted energy intensity$_{t-1}$)		0.021*	0.018
		(0.012)	(0.012)
Log (Output)			-0.119
			(0.087)
R-sq. (within)	0.025	0.048	0.062
No. of Obs	444	444	444

Do divestments have the opposite effect?

Divestments

- Defining divestments
  - Consider all plants with at least 20% of foreign equity
  - Define divestment as a drop in foreign equity to less than 20%
  - that remained below this threshold for at least three years

Balancing test

Variables	Unmatched sample (597 Divested vs 42,084 Foreign)			Matched sample (256 treated vs 256 controls)		
	Divested	Foreign	p-value	Treated	Control	p-value
Used in matching						
Log (Real output)$_{t-1}$	9.56	7.91	0.00	10.94	10.96	0.87
Log (Energy expenditure/output)$_{t-1}$	-4.04	-3.84	0.00	-4.21	-4.19	0.86
Log (Real output)$_{t-2}$	9.57	7.96	0.00	10.83	10.76	0.60
Log (Energy expenditure/output)$_{t-2}$	-3.97	-3.83	0.04	-4.13	-4.08	0.68

Balancing test

	Unmatched sample (597 Divested vs 42,084 Foreign)			Matched sample (256 treated vs 256 controls)		
	Divested	Foreign	p-value	Treated	Control	p-value
Unused in matching						
Log (Energy expenditure)$_{t-1}$	5.60	4.15	0.00	6.72	6.76	0.79
Log(Energy use)$_{t-1}$	8.51	7.11	0.00	9.66	9.69	0.80
Log (CO2 emission)$_{t-1}$	12.91	11.49	0.00	14.05	14.08	0.82
Log (Employment)$_{t-1}$	5.03	4.19	0.00	5.76	5.69	0.46
Exporter dummy$_{t-1}$	0.24	0.10	0.00	0.33	0.35	0.64
Share of imported materials$_{t-1}$	0.26	0.10	0.00	0.30	0.36	0.05
Share of skilled workers$_{t-1}$	0.20	0.14	0.00	0.22	0.21	0.39
Log(Investment in machinery)$_{t-1}$	7.79	5.66	0.00	8.84	8.96	0.55
Log(Energy use/output)$_{t-1}$	-1.13	-0.88	0.00	-1.28	-1.26	0.87
Log(CO2 emission/output)$_{t-1}$	3.27	3.51	0.00	3.11	3.13	0.89
Log(Energy exp./materials exp.)$_{t-1}$	-3.22	-3.00	0.00	-3.54	-3.37	0.19
Δ Log (Real output)$_{t-1}$	0.10	0.05	0.13	0.11	0.19	0.24
Δ Log (Energy expenditure)$_{t-1}$	0.03	0.06	0.49	0.03	0.08	0.51
Δ Log (Energy use)$_{t-1}$	0.03	0.08	0.23	0.02	0.10	0.40
Δ Log (CO2 emission)$_{t-1}$	0.03	0.08	0.23	0.02	0.10	0.43
Δ Log (Energy expenditure/output)$_{t-1}$	-0.06	0.01	0.09	-0.09	-0.11	0.78
Δ Log(Energy use/output)$_{t-1}$	-0.07	0.02	0.03	-0.09	-0.09	0.95
Δ Log(CO2 emission/output)$_{t-1}$	-0.07	0.03	0.03	-0.09	-0.10	0.91
Δ Log(Energy exp./materials exp.)$_{t-1}$	-0.05	0.01	0.21	-0.11	-0.13	0.77

Do divestments have the opposite effect?

	Acquisition Year	One Year Later	Two Years Later
		Log(Output)	
Post*Acquired	**-0.318***	**-0.397***	**-0.313***
	(0.081)	**(0.092)**	**(0.091)**
R-sq. (within)	0.030	0.038	0.035
No. of Obs.	1024	1024	1024
		Log (Energy expenditure/Output)	
Post*Acquired	**0.296***	**0.406***	**0.290**
	(0.099)	**(0.108)**	**(0.121)**
R-sq. (within)	0.021	0.035	0.016
No. of Obs.	1022	1022	1022
		Log (Energy use/Output)	
Post*Acquired	**0.296***	**0.454***	**0.258**
	(0.106)	**(0.119)**	**(0.126)**
R-sq. (within)	0.019	0.036	0.017
No. of Obs.	1022	1022	1022
		Log (CO2 emissions/Output)	
Post*Acquired	**0.289***	**0.453***	**0.249**
	(0.106)	**(0.120)**	**(0.126)**
R-sq. (within)	0.019	0.036	0.018
No. of Obs.	1022	1022	1022

Aggregate effects

Decomposition of aggregate energy intensity

Following Olley and Pakes (Econometrica, 1996):

$$\underbrace{W_t = \sum_i s_{it}\ lnEIP}_{\substack{\text{Aggregate weighted} \\ \text{energy intensity}}} = \underbrace{\overline{lnEIP}}_{\substack{\text{Unweighted average} \\ \text{energy intensity}}} + \underbrace{\sum_i (s_{it} - \bar{s}_t)(lnEIP_{it} - \overline{lnEIP})}_{Covariance}$$

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$$Y_{jst} = \beta Foreign_{jt} + \gamma_j + \lambda_{st} + \varepsilon_{jst}$$

where $Foreign_{jt}$ is the number of foreign affiliates or their industry output share, and j denotes 4-digit industry (79), s 2-digit sector (9) and t year (19).

Decomposition of aggregate energy intensity

	Measure based on number of FAs			Measure based on output share of FAs		
	W_t	$\overline{lnEIP}$	Covariance	W_t	$\overline{lnEIP}$	Covariance
Log (Energy Expenditure/Output)						
Foreign Affiliates	**-0.226*** **	**-0.086** **	**-0.140*** **	**-0.772* **	**-0.552** **	-0.219
	(0.041)	**(0.034)**	**(0.044)**	**(0.410)**	**(0.276)**	(0.318)
Adj. R-sq.	0.853	0.829	0.774	0.842	0.827	0.764
Observations	1408	1408	1408	1408	1408	1408
Log (Energy Use/Output)						
Foreign Affiliates	**-0.215*** **	**-0.070** **	**-0.146*** **	**-0.740* **	**-0.490* **	-0.250
	(0.039)	**(0.034)**	**(0.040)**	**(0.401)**	**(0.271)**	(0.336)
Adj. R-sq.	0.859	0.852	0.784	0.850	0.851	0.775
Observations	1408	1408	1408	1408	1408	1408
Log (CO2 Emissions/Output)						
Foreign Affiliates	**-0.217*** **	**-0.077** **	**-0.140*** **	**-0.761* **	**-0.521* **	-0.239
	(0.039)	**(0.035)**	**(0.040)**	**(0.405)**	**(0.277)**	(0.328)
Adj. R-sq.	0.853	0.834	0.783	0.844	0.833	0.775
Observations	1408	1408	1408	1408	1408	1408
No. of industries (4-digit ISIC)	79	79	79	79	79	79
No. of sectors (2-digit ISIC)	9	9	9	9	9	9
No. of years	19	19	19	19	19	19

Decomposition of aggregate energy intensity (Different normalization)

	Measure based on number of FAs			Measure based on output share of FAs		
	W_t	$\overline{lnEIP}$	Covariance	W_t	$\overline{lnEIP}$	Covariance
Log (Energy Expenditure/Materials)						
Foreign Affiliates	**-0.254*** **	**-0.093** **	**-0.161** **	**-0.822* **	**-0.698** **	-0.125
	(0.061)	**(0.043)**	**(0.065)**	**(0.454)**	**(0.307)**	(0.381)
Adj. R-sq.	0.873	0.874	0.789	0.863	0.874	0.779
Observations	1407	1407	1407	1407	1407	1407
Log (Energy Use/Materials)						
Foreign Affiliates	**-0.243*** **	**-0.076* **	**-0.167*** **	**-0.788* **	**-0.628** **	-0.160
	(0.058)	**(0.041)**	**(0.060)**	**(0.444)**	**(0.299)**	(0.392)
Adj. R-sq.	0.881	0.882	0.804	0.872	0.883	0.794
Observations	1407	1407	1407	1407	1407	1407
Log (CO2 Emissions/Materials)						
Foreign Affiliates	**-0.244*** **	**-0.082** **	**-0.162*** **	**-0.804* **	**-0.657** **	-0.147
	(0.057)	**(0.041)**	**(0.060)**	**(0.450)**	**(0.301)**	(0.386)
Adj. R-sq.	0.877	0.872	0.805	0.868	0.873	0.796
Observations	1407	1407	1407	1407	1407	1407
No. of industries (4-digit ISIC)	79	79	79	79	79	79
No. of sectors (2-digit ISIC)	9	9	9	9	9	9
No. of years	19	19	19	19	19	19

Conclusions

- Foreign acquisitions **increase production volume**, which in turn **increases energy use** and CO_2 **emissions**
- But they **reduce energy and emission intensities** by 28 and 30%, respectively
- **Foreign divestments** have the **opposite effect**
- FDI contributes to **aggregate improvements** in energy efficiency, both through **within-plant improvement** and **reallocation**

Thank you!

APPENDICES

Robustness Check: Matches from Another Kabupaten

	Acquisition Year	1 Year Later	2 Years Later
		Log(Output)	
Post*Acquired	**0.829***** **(0.114)**	**1.037***** **(0.116)**	**1.008***** **(0.123)**
R-sq. (within)	0.199	0.238	0.225
No. of Obs.	836	836	836
		Log (Energy Expenditure in Rps)	
Post*Acquired	**0.573***** **(0.118)**	**0.758***** **(0.126)**	**0.701***** **(0.134)**
R-sq. (within)	0.145	0.173	0.161
No. of Obs.	834	834	831
		Log (Energy Expenditure/Output)	
Post*Acquired	**-0.262**** **(0.119)**	**-0.286**** **(0.119)**	**-0.324**** **(0.128)**
R-sq. (within)	0.012	0.015	0.016
No. of Obs.	834	834	831

◂ Back to "Robustness Checks"

Is it just about markups?

	Acquisition Year	1 Year Later	2 Years Later
	Log(Energy Expenditure/**Materials Expenditure**)		
Post*Acquired	**-0.310****	**-0.266****	**-0.382****
	(0.123)	**(0.128)**	**(0.147)**
R-sq. (within)	0.021	0.011	0.018
No. of Obs.	808	810	807
	Log(Energy Expenditure/Output)		
Post*Acquired	**-0.266****	**-0.290****	**-0.331*****
	(0.117)	**(0.117)**	**(0.126)**
Export share	-0.002	0.001	0.001
	(0.002)	(0.002)	(0.002)
R-sq. (within)	0.016	0.015	0.016
No. of Obs.	838	838	835
	Log(Energy Expenditure/Output)		
Post*Acquired	**-0.317****	**-0.382*****	**-0.406*****
	(0.134)	**(0.136)**	**(0.146)**
Export share	-0.003	-0.001	-0.001
	(0.002)	(0.002)	(0.002)
Post*Acquired*Export share	0.003	0.004	0.004
	(0.003)	(0.003)	(0.003)
R-sq. (within)	0.018	0.023	0.021
No. of Obs.	838	838	835

◂ Back to "Robustness Checks"

Matched Sample: Dropping years beyond 1997

	Acquisition Year	1 Year Later	2 Years Later
		Log(Output)	
Post*Acquired	**0.793*** **	**0.777*** **	**0.798*** **
	(0.125)	**(0.134)**	**(0.156)**
R-sq. (within)	0.236	0.281	0.291
No. of Obs.	714	654	614
		Log (Energy expenditure in Rps)	
Post*Acquired	**0.519*** **	**0.647*** **	**0.492*** **
	(0.133)	**(0.152)**	**(0.184)**
R-sq. (within)	0.134	0.174	0.136
No. of Obs.	714	654	613
		Log (Energy expenditure/Output)	
Post*Acquired	**-0.273** **	-0.130	**-0.310* **
	(0.131)	(0.130)	**(0.160)**
R-sq. (within)	0.019	0.012	0.031
No. of Obs.	714	654	613

◂ Back to "Robustness Checks"

Longer time period

	Acquisition Year	1 Year Later	2 Years Later	3 Years Later	4 Years Later	5
			Log(Output)			
Post*Acquired	0.728***	0.839***	0.813***	1.033***	1.104***	
	(0.135)	(0.139)	(0.150)	(0.170)	(0.180)	
R-sq. (within)	0.247	0.316	0.281	0.299	0.292	
No. of Obs.	462	462	462	462	462	
			Log (Energy Expenditure in Rps)			
Post*Acquired	0.430***	0.593***	0.500***	0.306	0.420**	
	(0.152)	(0.159)	(0.183)	(0.198)	(0.186)	
R-sq. (within)	0.124	0.184	0.141	0.138	0.206	
No. of Obs.	454	454	454	454	454	
			Log (Energy Expenditure/Output)			
Post*Acquired	-0.308**	-0.272**	-0.345**	-0.718***	-0.675***	-
	(0.134)	(0.126)	(0.161)	(0.157)	(0.155)	
R-sq. (within)	0.025	0.024	0.019	0.087	0.084	
No. of Obs.	454	454	454	454	454	

Back to "Robustness Checks"

Balancing Test: Variables used in matching

Variables	CEM			PSM (no same county)			IPTW	
	(N=440)			(N=418)			(N=143,216)	
	Treated	Control	p-value	Treated	Control	p-value	F-Stat	p-value
Used in matching								
Log (Real Output)	9.03	9.03	0.99	9.86	9.86	0.90	4.43	0.04
Log (Energy Expenditure/Output)	-3.71	-3.71	0.99	-3.82	-3.82	0.65	0.80	0.37
Log (Real Output)	9.59	9.62	0.90	9.86	9.86	0.90	5.91	0.02
Log (Energy Expenditure/Output)	-3.77	-3.79	0.92	-3.82	-3.82	0.65	0.02	0.89

Back to "Robustness Checks"

Balancing Test: Variables NOT used in matching

Variables	CEM			PSM (no same county)			IPTW	
	(N=440)			(N=418)			(N=143,216)	
	Treated	Control	p-value	Treated	Control	p-value	F-Stat	p-value
Unused in matching								
Log (Energy Expenditure)	5.33	5.33	0.99	6.03	6.03	0.84	6.23	0.01
Log (Energy Use)	8.25	8.26	0.95	8.99	8.99	0.77	5.42	0.01
Log (CO2 Emissions)	12.65	12.66	0.94	13.36	13.36	0.78	0.02	0.02
Log (Employment)	4.85	4.72	0.26	5.26	5.26	0.40	4.59	0.00
Exporter Dummy	0.15	0.18	0.30	0.18	0.18	0.80	14.42	0.03
Share of Imported Materials	0.20	0.18	0.56	0.19	0.19	0.05	12.14	0.00
Share of Skilled Workers	0.19	0.20	0.63	0.21	0.21	0.25	17.91	0.00
Log(Investment in Machineries)	7.15	6.93	0.43	7.86	7.86	0.20	0.61	0.00
Log(Energy Use/Output)	-0.80	-0.79	0.93	-0.87	-0.87	0.56	0.22	0.43
Delta Log (Energy Expenditure)	0.14	0.08	0.19	0.15	0.15	0.55	0.03	0.90
Delta Log (Energy Use)	0.17	0.09	0.19	0.18	0.18	0.72	0.00	0.87
Delta Log (CO2 Emissions)	0.17	0.09	0.22	0.18	0.18	0.70	10.36	0.97
Log(CO2 Emissions/Output)	3.61	3.62	0.92	3.51	3.51	0.57	7.45	0.64
Log(Energy Exp./Materials)	-2.80	-2.81	0.93	-3.03	-3.03	0.32	0.39	0.01
Delta Log (Real Output)	0.13	0.05	0.14	0.14	0.14	0.86	2.05	0.53
Delta Log (Energy Expenditure/Output)	0.02	0.03	0.81	0.02	0.02	0.60	1.93	0.15
Delta Log(Energy Use/Output)	0.05	0.04	0.87	0.04	0.04	0.81	1.48	0.16
Delta Log(CO2 Emissions/Output)	0.04	0.04	0.96	0.04	0.04	0.78	1.66	0.22
Delta Log(Energy Exp./Materials)	0.08	-0.02	0.08	0.04	0.04	0.81	0.00	0.20

◂ Back to "Robustness Checks"

Coarsened Exact Matching-DID Estimates

	Acquisition Year	1 Year Later	2 Years Later
		Log(Output)	
Post*Acquired	**1.392*** **	**1.499*** **	**1.530*** **
	(0.141)	**(0.144)**	**(0.148)**
R-sq. (within)	0.350	0.383	0.392
No. of Obs.	876	876	876
		Log (Energy Expenditure in Rps)	
Post*Acquired	**1.012*** **	**1.189*** **	**1.159*** **
	(0.140)	**(0.149)**	**(0.158)**
R-sq. (within)	0.221	0.248	0.253
No. of Obs.	871	868	868
		Log (Energy Expenditure/Output)	
Post*Acquired	**-0.372*** **	**-0.297** **	**-0.382*** **
	(0.113)	**(0.121)**	**(0.123)**
R-sq. (within)	0.059	0.054	0.048
No. of Obs.	871	868	868

◂ Back to "Robustness Checks"

IPW-DID Estimates

	Acquisition Year	1 Year Later	2 Years Later
		Log(Output)	
Post*Acquired	**1.659*** **	**1.763*** **	**1.906*** **
	(0.184)	**(0.218)**	**(0.221)**
R-sq. (within)	0.803	0.807	0.809
No. of Obs.	138750	138750	138750
		Log (Energy Expenditure in Rps)	
Post*Acquired	**1.353*** **	**1.421*** **	**1.399*** **
	(0.176)	**(0.199)**	**(0.220)**
R-sq. (within)	0.806	0.802	0.800
No. of Obs.	138011	138009	138008
		Log (Energy Expenditure/Output)	
Post*Acquired	**-0.324*** **	**-0.358*** **	**-0.516*** **
	(0.120)	**(0.133)**	**(0.159)**
R-sq. (within)	0.640	0.649	0.638
No. of Obs.	138011	138009	138008

Back to "Robustness Checks"

Regression Result: Scale Effect

Dependent Variable: Log(Energy Expenditure)

	All Sample		Matched Sample	
	(1)	(2)	(3)	(4)
Acquired	**0.836**** **(0.329)**	**2.334***** **(0.250)**	**0.997**** **(0.404)**	**1.931***** **(0.462)**
ln(output)	**0.571***** **(0.005)**		**0.621***** **(0.040)**	
ln(output)t-1		**0.272***** **(0.005)**		**0.250***** **(0.046)**
Acquired*ln(output)	**-0.060**** **(0.030)**		**-0.086**** **(0.038)**	
Acquired*ln(output)t-1		**-0.176***** **(0.022)**		**-0.144***** **(0.043)**
Firm fixed effect	Yes	Yes	Yes	Yes
Year-fixed effect	Yes	Yes	Yes	Yes
R-sq. (within)	0.261	0.097	0.389	0.134
No. of Obs.	255450	228733	2994	2571

◂ Back to "Energy Intensity vs Scale"