Firm Structure, Environmental Regulation, and Manufacturing Activities∗

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Introduction

The firm structure (i.e., multi-plant) plays an important role in determining plant location decisions. Multi-plant firms:
- employ 78% of the manufacturing workforce
- produce 88% of output
- are likely to emit pollution over 100 tons per year
- hence are easily targeted by environmental regulations

Thus, multi-plant firms may respond differently than single-plant firms in response to regulatory controls.

Research Questions

The impact of environmental regulation (i.e., Clean Air Act Amendments) on plants’ shutdown decisions:
- whether a multi-plant firm is more or less likely to close its affiliated plant than a single-plant firm does in the presence of environmental pressures.

Data


Data Sources

Plant data: National Establishment Time Series database
County data: County Business Pattern, Environmental Protection Agency
Industry data: Census of Bureau

Variables of Interest

Plant death: If a plant is closed at time t, = 0 otherwise
Multi-plant: If an existing plants affiliated with the same headquarters at time t, = 0 otherwise
Regulation: If a county is subject to any pollution specific (i.e., SO2, CO, O3, and TSPs) nonattainment status at t, = 0 otherwise
Size: Log (employment)
Productivity: Log (deflated sales per employment)
Age: Plant operation years
Export dummy: If a plant exports, = 0 otherwise
Takeover: If a plant changed headquarters at time t, = 0 otherwise
Hdq. external: If of existing plants affiliated with the same headquarters, in the same industry and located in the same county at t
Agglomeration: If of existing plants in the same county but outside of its own industry
Road density: road length per land area by county
Unemployment rate: unemployment rate by county-year
Industry-county-wage: wage rate by county-industry-year
Industry entry costs: 1 – min [entry rate_j, exit rate_j]

Methodology and Results

Dependent Var: Death

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
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</thead>
<tbody>
<tr>
<td>Multi-Plant</td>
<td>0.0139***</td>
<td>0.0127***</td>
<td>0.0131***</td>
</tr>
<tr>
<td>Reg.</td>
<td>-0.0148***</td>
<td>-0.0124***</td>
<td>-0.0139***</td>
</tr>
<tr>
<td>Reg × Multi-Plant</td>
<td>0.0147***</td>
<td>0.0153***</td>
<td>0.0153***</td>
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<tr>
<td>Size</td>
<td>-0.0035***</td>
<td>-0.0030***</td>
<td>-0.0030***</td>
</tr>
<tr>
<td>Productivity</td>
<td>0.0028***</td>
<td>0.0011***</td>
<td>-0.0028***</td>
</tr>
<tr>
<td>Age</td>
<td>0.0001</td>
<td>0.0008***</td>
<td>0.0009***</td>
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<tr>
<td>Export Dummy</td>
<td>-0.0138***</td>
<td>-0.0137***</td>
<td>-0.0125***</td>
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<tr>
<td>Size</td>
<td>0.0115***</td>
<td>0.0105***</td>
<td>0.0105***</td>
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<td>Takeover</td>
<td>0.0219***</td>
<td>0.0204***</td>
<td>0.0205***</td>
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<tr>
<td>Hdq. External</td>
<td>0.0064***</td>
<td>0.0068***</td>
<td>0.0063***</td>
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<td>Agglomeration</td>
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<td>0.0002</td>
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<tr>
<td>Road Density</td>
<td>0.0008</td>
<td>0.0014</td>
<td>0.0014</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>-0.0001</td>
<td>0.0010**</td>
<td>0.0011**</td>
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<tr>
<td>Industry-County Wage</td>
<td>0.0138***</td>
<td>0.0007</td>
<td>0.0076***</td>
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<tr>
<td>Industry Entry Costs</td>
<td>-0.0195***</td>
<td>-0.1054</td>
<td>-0.0448***</td>
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<td>Year Fixed Effect</td>
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<td>Y</td>
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<tr>
<td>Industry Fixed Effect</td>
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<tr>
<td>State Fixed Effect</td>
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<td>Y</td>
<td>Y</td>
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</table>

Note: the coefficients give the marginal effects of changing the independent variables estimated from probit models. All specifications have 90,265 observations. Standard errors in parenthesis are adjusted for clustering at the plant level. Industry dummies are calculated at the 2-digit SIC level. *** significant at the 1 percent level, ** significant at the 5 percent level, * significant at the 10 percent level.

Probit model: 

\[ Pr(D | \text{death}_t = 1| \text{X}_t)\] 

\[= \Phi(\beta_0 + \beta_1 \text{Plant} + \beta_2 \text{Plant} + \beta_3 \text{Plant} + \epsilon_t) \]

where: 

- i: plant 
- j: industry 
- c: county 
- y: year 
- \(\beta_0\): plant characteristics 
- \(\beta_1\): industry-by-year var. 
- \(\beta_2\): county-by-industry time variant factors 
- \(\epsilon_t\): the stochastic error term

Robustness Checks

The results are robust to the following robustness checks:
- Lags of environmental regulations
- current-year nonattainment status
- one-year lag nonattainment status
- two-year lag nonattainment status
- Pollutant-specific nonattainment status
- SO2, CO, O3, and TSPs, respectively
- Measures of headquarters externality
  - if of existing plant affiliated with the same headquarters and located in the same county
  - if of existing plant affiliated with the same headquarters and located in the same county within the same industry in the 2-digit SIC or 3-digit SIC
- Measures of agglomeration
  - if of existing plants located in the county
  - if of existing plants located in the county but not affiliated with the same headquarters
- Cluster standard errors
- cluster at the 2-digit SIC, 3-digit SIC, and headquarters
- And more needs to be done

Conclusions

- Multi-plant firms are more likely to close an affiliated plant than single-plant firms, even in the presence of environmental pressures, conditioning plant, county, and industry characteristics.

An appealing research direction is to explore how multi-plant firms respond to tightened environmental controls.
- do they shift production resources from plants in regulated areas to those in unregulated ones?
- or do they relocate or close the whole dirty plants

References