The Limits of Limited Liability: Evidence from Industrial Pollution

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*University of Toronto*

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*Boston College*
“The limited-liability company is one of man’s greatest inventions.”
— The Economist, 2016
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However, an inherent **moral hazard problem**
- Firms’ assets may not be enough to cover claims
- Incentive for privately profitable, socially costly behavior
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- Firms’ assets may not be enough to cover claims
- Incentive for privately profitable, socially costly behavior

A number of mitigating factors:

- Minimum capital requirements
- Regulation
- Legal liability
Owners liable for corp acts in limited circumstances

- Largely confined to closely held corps and parent-sub relationships

This paper: Study parent liability for subs' environmental cleanups

Our question: How does limited liability in the parent-sub context affect subs' incentives to pollute and economic activities?
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This paper: Study parent liability for subs’ environmental cleanups
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**This paper:** Study parent liability for subs’ environmental cleanups

**Our question:** *How does limited liability in the parent-sub context affect subs’ incentives to pollute and economic activities?*
Empirical setting

- Strengthened LL protection for some parents under CERCLA
- Overruled circuit courts that previously adopted weaker standards
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- Overruled circuit courts that previously adopted weaker standards

Methodology: Exploit circuit split in diff-in-diff framework
Stronger limited liability protection associated with:

5–9% increase in toxic emissions

Driven by less-solvent subs

Lower investment in pollution abatement

No evidence of change in production or reallocation across plants

Results driven by parents with high risk of distress

Consistent with a harm-shifting motivation

Findings highlight moral hazard problems associated with limited liability protection.
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Institutional Background
CERCLA – Overview

*Comprehensive Environmental Compensation, Response, and Liability Act* (AKA *Superfund*)

Passed by Congress in 1980; response to Love Canal disaster

Goal = Address ex-post cleanup of toxic sites

Currently 1,300+ sites on the National Priorities List (NPL) that are eligible for cleanup
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CERCLA – Legislative goal

1. Clean up legacy sites
   - 1979 EPA study: 30–50K abandoned sites in US; 1200–2000 posed public health risk

2. Deter creation of future sites
   - “Induce the highest standard of care” (Senator Stafford)
   - “Powerful incentives to deter risky industrial and commercial practices that can result in releases” (EPA, 2011)
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CERCLA cleanups are costly

- Love Canal cleanup cost: $400 million
CERCLA cleanups are costly

- Love Canal cleanup cost: $400 million
- More recent examples of CERCLA claims:
  - Hercules Chemical Corp: $900 million
  - Marcal Paper Mills Inc: $943 million
  - Chemtura Corp: $2.0 billion
  - Asarco LLC: $3.6 billion
Two statutory mechanisms to pay for cleanups:

1. Superfund
   - Trust fund that pays for cleanup if responsible party is unable or can't be identified

2. Liability rules
   - CERCLA also imposes liability on "owners or operators"
   - Federal circuit courts adopted different standards for parent liability
Paying for cleanups

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CERCLA liability standards

Circuit courts adopted different standards for parent liability:

1. Ability-to-Control (ATC) — imposed liability on parents that had the power to control the activities of the polluter.

2. Actual-Control (AC) — imposed liability on the parent if the subsidiary did not act independently (e.g., overlapping directors).

3. Veil Piercing — imposed liability if the corporate veil could be pierced under state law.
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Map of liability standards

- Corporate Veil Piercing (Control Group)
- Ability to Control (Treatment Group 2)

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Rejected **Ability-to-Control** and **Actual-Control** standards

- Requires showing abuse of corporate form (e.g., fraud, undercapitalization, "alter ego")
- Direct operation of sub's facility by parent also grounds for liability
  - E.g., employee of parent (but not sub) controls hazardous waste operations of sub

Rejected **Ability-to-Control** and **Actual-Control** standards

- Parents liable for cleanups under **veil piercing standard**
  - Requires showing abuse of corporate form (e.g., fraud, undercapitalization, “alter ego”)
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Methodology & Data
Empirical strategy

We use Bestfoods as a natural experiment in a diff-in-diff framework:

\[ Y_{c,p,t,i} = \beta \text{Bestfoods}_{p,t} + \alpha_p + \alpha_{i,t} + \alpha_{c,t} + \epsilon_{c,p,t,i} \]

- \( \text{Bestfoods}_{p,t} \) — equals one after decision for ATC/AC subs
  - Liability standard based on plant’s location
- \( \alpha_p \) — plant fixed-effect
- \( \alpha_{c,t} \) — chemical×year fixed-effect
- \( \alpha_{i,t} \) — parent company×year fixed-effect
- Some specifications include industry×year fixed-effects
Data sources

- **Plant toxic emissions** – *EPA Toxic Release Inventory*
  - Pounds of ground, water, and air emissions at chemical level
  - 7,833 parent corps; average 3 subs using 4 chemicals

- **Pollution abatement activities** – *EPA P2 database*
  - Facilities report if they undertook abatement related to operating practices, production process, etc.

- **Plant production** – *EPA P2 database*
  - Facilities report “production ratios” — e.g., \[
  \frac{\text{# Refrigerators Produced}_t}{\text{# Refrigerators Produced}_{t-1}}
  \]
Results
Does parent liability affect subsidiary toxic emissions?

Main focus of CERCLA: **Ground pollution**

Examples:
- Landfills
- Surface impoundments
- Injection wells
- Spills and leaks released into the ground
Ground pollution increases

<table>
<thead>
<tr>
<th></th>
<th>All Subs</th>
<th>Subs w/ Public Parent</th>
<th>Non-Subs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td><strong>Bestfoods</strong></td>
<td>0.0861***</td>
<td>0.0812***</td>
<td>0.220***</td>
</tr>
<tr>
<td></td>
<td>(0.0193)</td>
<td>(0.0188)</td>
<td>(0.0309)</td>
</tr>
<tr>
<td><strong>Plant FE</strong></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td><strong>Chem-Year FE</strong></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td><strong>Parent-Year FE</strong></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td><strong>Industry-Year FE</strong></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>488,739</td>
<td>488,009</td>
<td>154,404</td>
</tr>
<tr>
<td><strong>R-squared</strong></td>
<td>0.683</td>
<td>0.688</td>
<td>0.741</td>
</tr>
</tbody>
</table>

Economic magnitude: Increase of 5–9% relative to sample mean
Coefficient dynamics

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Robustness tests

Results are robust to...

- Omitting any individual circuit court
- Limiting treated group to AC or ATC regions
- Using proportion of ground pollution as outcome
- Collapsing observations
- Alternative clustering of SEs (e.g., by state and parent company)
The Channel
We consider 3 potential channels:

1. Decreased abatement ▶ Stronger LL protections may weaken incentives to invest in pollution abatement
2. Increased production ▶ Stronger LL protections decrease cost of polluting
3. Reallocation across plants ▶ See paper for details
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   - *See paper for details*
Pollution abatement = 5–7% of capex

Measure using the EPA’s Pollution Prevention (P2) database

→ Indicator for different types of abatement

Most common types:

1. **Operating practices** [e.g., improved record-keeping, monitoring]
2. **Production process** [e.g., modified equipment, optimized reaction conditions, used biotech]
Decrease in abatement related to production process

<table>
<thead>
<tr>
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<th>1(Abatement - Operations)</th>
<th>1(Abatement - Process)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All Subs</td>
<td>All Subs</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Bestfoods</td>
<td>0.000998</td>
<td>0.00194</td>
</tr>
<tr>
<td></td>
<td>(0.00533)</td>
<td>(0.00713)</td>
</tr>
<tr>
<td>Plant FE</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Chem-Year FE</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Parent-Year FE</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Industry-Year FE</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Observations</td>
<td>593,533</td>
<td>592,592</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.601</td>
<td>0.611</td>
</tr>
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</table>

Economic magnitude: Decrease of 12–25% in process-related abatement
Increased pollution may also reflect more economic activity

→ *Bestfoods* decreases cost of polluting
Increased pollution may also reflect more economic activity → *Bestfoods* decreases cost of polluting

We measure this using the *production ratio* reported to the EPA
No evidence of change in production

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<td></td>
<td>(1)</td>
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<tr>
<td><strong>Bestfoods</strong></td>
<td>0.0097</td>
<td>0.0028</td>
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<tr>
<td></td>
<td>(0.0073)</td>
<td>(0.0062)</td>
</tr>
<tr>
<td>Plant FE</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Chem-Year FE</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Industry-Year FE</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>463,955</td>
<td>463,336</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.482</td>
<td>0.502</td>
</tr>
</tbody>
</table>

Also no effect on estimated employment from D&B
Interpretation

- Evidence suggests emissions not driven by increased production
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Potentially reflects {fixed costs} associated with future cleanups

- “Land cleanup is distinct from many environmental regulatory programs because much of the cleanup cost burden is comprised of fixed costs” (EPA 2011)
Interpretation

- Evidence suggests emissions not driven by increased production
- Potentially reflects **fixed costs** associated with future cleanups
  - “Land cleanup is distinct from many environmental regulatory programs because much of the cleanup cost burden is comprised of fixed costs” (EPA 2011)
- Also less need for **current abatement** with fixed costs
  - E.g., changes to production process
Cross-sectional tests

1. **Subsidiary solvency**
   - Parent liability more likely for less solvent subsidiaries
   - Measure solvency at plant-level using **Paydex Score**
Cross-sectional tests

1. **Subsidiary solvency**
   - Parent liability more likely for less solvent subsidiaries
   - Measure solvency at plant-level using **Paydex Score**

2. **Parent distress risk**
   - Firms in distress have incentive to shift harm to other stakeholders
   - May view investments in abatement as less important than short-term financing needs
## Results driven by less-solvent subs

<table>
<thead>
<tr>
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<th>Ground Pollution</th>
<th>1(Abatement - Process)</th>
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<tbody>
<tr>
<td><strong>Bestfoods</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>0.0859**</td>
<td>-0.0170**</td>
</tr>
<tr>
<td></td>
<td>(0.0365)</td>
<td>(0.0062)</td>
</tr>
<tr>
<td>(2)</td>
<td>0.0893*</td>
<td>-0.0168**</td>
</tr>
<tr>
<td></td>
<td>(0.0491)</td>
<td>(0.0069)</td>
</tr>
<tr>
<td>Observations</td>
<td>154,256</td>
<td>154,256</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.666</td>
<td>0.524</td>
</tr>
<tr>
<td><strong>Bestfoods</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>-0.0503*</td>
<td>0.00829</td>
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<tr>
<td></td>
<td>(0.0270)</td>
<td>(0.0143)</td>
</tr>
<tr>
<td>(4)</td>
<td>-0.0563</td>
<td>0.0194</td>
</tr>
<tr>
<td></td>
<td>(0.0325)</td>
<td>(0.0132)</td>
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<tr>
<td>Observations</td>
<td>140,396</td>
<td>140,398</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.708</td>
<td>0.519</td>
</tr>
</tbody>
</table>

- **Observations**: 154,256, 153,809, 154,256, 153,809
- **R-squared**: 0.666, 0.677, 0.524, 0.547

### Plant FE
- **Low Plant Paydex**: x, x, x, x
- **High Plant Paydex**: x, x, x, x

### Chem-Year FE
- **Low Plant Paydex**: x, x, x, x
- **High Plant Paydex**: x, x, x, x

### Parent-Year FE
- **Low Plant Paydex**: x, x, x, x
- **High Plant Paydex**: x, x, x, x

### Industry-Year FE
- **Low Plant Paydex**: x, x, x, x
- **High Plant Paydex**: x, x, x, x

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Results driven by parents with higher distress risk

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<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td><strong>Bestfoods</strong></td>
<td>0.378***</td>
<td>0.389***</td>
</tr>
<tr>
<td></td>
<td>(0.0756)</td>
<td>(0.111)</td>
</tr>
<tr>
<td>Observations</td>
<td>69,690</td>
<td>69,225</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.782</td>
<td>0.787</td>
</tr>
</tbody>
</table>

|                      | -0.0300***       | -0.0300***             |
|                      | (0.0078)         | (0.0059)               |
| Observations         | 69,690           | 69,225                 |
| R-squared            | 0.454            | 0.497                  |

<table>
<thead>
<tr>
<th></th>
<th>High Parent Z-Score</th>
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<tbody>
<tr>
<td><strong>Bestfoods</strong></td>
<td>0.125**</td>
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<tr>
<td></td>
<td>(0.0489)</td>
</tr>
<tr>
<td>Observations</td>
<td>65,753</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.584</td>
</tr>
</tbody>
</table>

|                      | -0.0090            | -0.0116              |
|                      | (0.0083)           | (0.0143)             |
| Observations         | 65,754             | 65,346               |
| R-squared            | 0.413              | 0.454                |

Plant FE        x  x  x  x
Chem-Year FE    x  x  x  x
Parent-Year FE  x  x  x  x
Industry-Year FE x  x  x

Akey & Appel: The Limits of Limited Liability
Conclusion

- We study tradeoffs of limited liability in the parent–sub context.

Key findings:
- Stronger liability protection associated with higher sub emissions.
- Drop in abatement; no change in production or allocation of emissions across plants.
- Effects driven by less-solvent subs and parents with higher risk of distress.

Findings highlight moral hazard problem associated with limited liability, though aggregate welfare effects unclear.
We study tradeoffs of limited liability in the parent–sub context.

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