Pass-Through in a Concentrated Industry: Empirical Evidence and Policy Implications

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Research question

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These are useful questions to answer.

- Pass-through is central to wide range of analyses
- Theory predictions on pass-through are ambiguous
- Large empirical literature on pass-through...

  but little that accounts for oligopoly interactions

Our contribution

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Develop and estimate an empirical model of pass-through

- Incorporates oligopoly interactions
- Disentangles effect of firm-specific cost changes from industry-wide cost changes
- Identifies the role of competition in pass-through
- Can be estimated with aggregated price data
- Apply results to antitrust and environmental policy

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Main regression results

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2. Own pass-through is incomplete and decreases with competition
3. Cross pass-through effects – how firms adjust prices with competitors' costs – account for this divergence

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Similar to theoretical predictions of Cournot model with convex demand curve (ten Kate and Niels 2005)

Why portland cement?

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1. Amendments to the NESHAP regulations on (local) air pollutants take effect September 2015
2. Cement accounts for $\approx 5\%$ of global CO_2 emissions. How would cap-and-trade affect firms and consumers?
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All of these events can be analyzed with pass-through.

Motivation for the empirical model

Objective: Obtain estimates of how each plant adjust prices with its costs and the costs of its competitors

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Obstacle: Plant-level prices are not observed

Build a model of regional prices that has reasonable plant-level micro-foundations and can be taken to the data

Plant pricing in equilibrium

Plant pricing in equilibrium

Linear approximation to equilibrium price of plant j in period t

$$p_{jt} = \rho_{jjt} c_{jt} + \sum_{k \neq j} \rho_{jkt} c_{kt} + x'_{jt}\gamma + \mu_j + \tau_t + \epsilon_{jt}$$

- Cost coefficients summarize pass-through
  - ρ_{jjt} is own pass-through
  - ρ_{jkt} for $j \neq k$ is cross pass-through
  - Industry pass-through is $\rho^M_{jt} = \sum_k \rho_{jkt}$
- x_{jt} contains control variables
- μ_j and τ_t are plant and year fixed effects

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1. Model is general: prices based on equilibrium strategies, given a demand schedule and some competitive game
2. Cannot be estimated due to curse of dimensionality ($J \times J \times T$ pass-through parameters)

Restrictions on pass-through

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2. Own pass-through linearly affected by number, proximity of competitors

Linearity facilitates aggregation

Pass-through can be estimated with regional price data and properly aggregated plant-level fuel costs data

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1. No regional boundaries are imposed on the competitive environment
2. All regressors constructed by aggregating plant-level variables to region level
3. Plants affect prices outside their region via cross pass-through

Estimation

OLS

- Simple, advantageous small sample properties
- Clustering by region for standard errors (Wooldridge 2010)

FGLS

- Adjust for first-degree autocorrelation
- Possible efficiency gains

Bayesian Regression

- Account for *plant-level* autocorrelation, spatial correlations
- Fully preserves micro-foundations

Stylized facts about cement production

Stylized facts about cement production

1. Kilns transform raw materials (limestone) into clinker
2. Clinker is ground into cement after cooling
3. Cement forms concrete when mixed with water and aggregates (e.g., sand or stone)
4. Kilns are energy intensive and fired with fossil fuels
5. Transportation costs are large, differentiation is (predominantly) spatial

Data span United States, 1974-2010

Empirical variation in fuel costs:

1. Observable heterogeneity in kiln fuel efficiency
2. Time-series variation in fossil fuel prices
3. Heterogeneity in choice of fossil fuel

Empirical variation in competitive conditions:

1. Entry and exit
2. Changes in gasoline prices

Table : Regression Results with the Baseline Specification

	OLS		FGLS		Bayesian	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Fuel Costs	0.99	1.01	1.02	1.16	1.1	1.31
	(0.23)	(0.23)	(0.15)	(0.24)	(0.17)	(0.16)
Fuel Costs × Inverse Rival Distance	-5.49	-4.14	-6.95	-5.09	-3.1	-3.75
	(1.71)	(1.70)	(0.67)	(0.97)	(0.95)	(1.01)
Rival Fuel Costs × Inverse Rival Distance	5.07	3.52	6.93	4.55	3.1	3.62
	(2.07)	(2.18)	(0.77)	(1.15)	(1.03)	(1.09)
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1. Cournot competition with local markets
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3. First order approximation (Jaffe-Weyl 2013, MRRS 2014)

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2. Low pricing of one partner forgoes profit from other partner
3. Magnitude of opportunity cost is “upward pricing pressure”
4. Calculate first order effects of mergers based on (i) magnitude of opportunity costs and (ii) observed pass-through behavior

Table : Price Effects of a Holcim/Lafarge Merger

City	State	Pre-Divestiture Price Effect	Post-Divestiture Price Effect
		Holcim Plants	
Bloomsdale	MO	6.6%	4.70%
Holly Hill	SC	6.3%	.
Theodore	AL	8.2%	.
Catskill	NY	8.1%	.
Hagerstown	MD	4.5%	4.2%
		Lafarge Plants	
Ravena	NY	7.4%	2.5%
Calera	AL	3.7%	.
Grand Chain	IL	3.1%	3.0%
Sugar Creek	MO	4.0%	.
Tulsa	OK	4.9%	.

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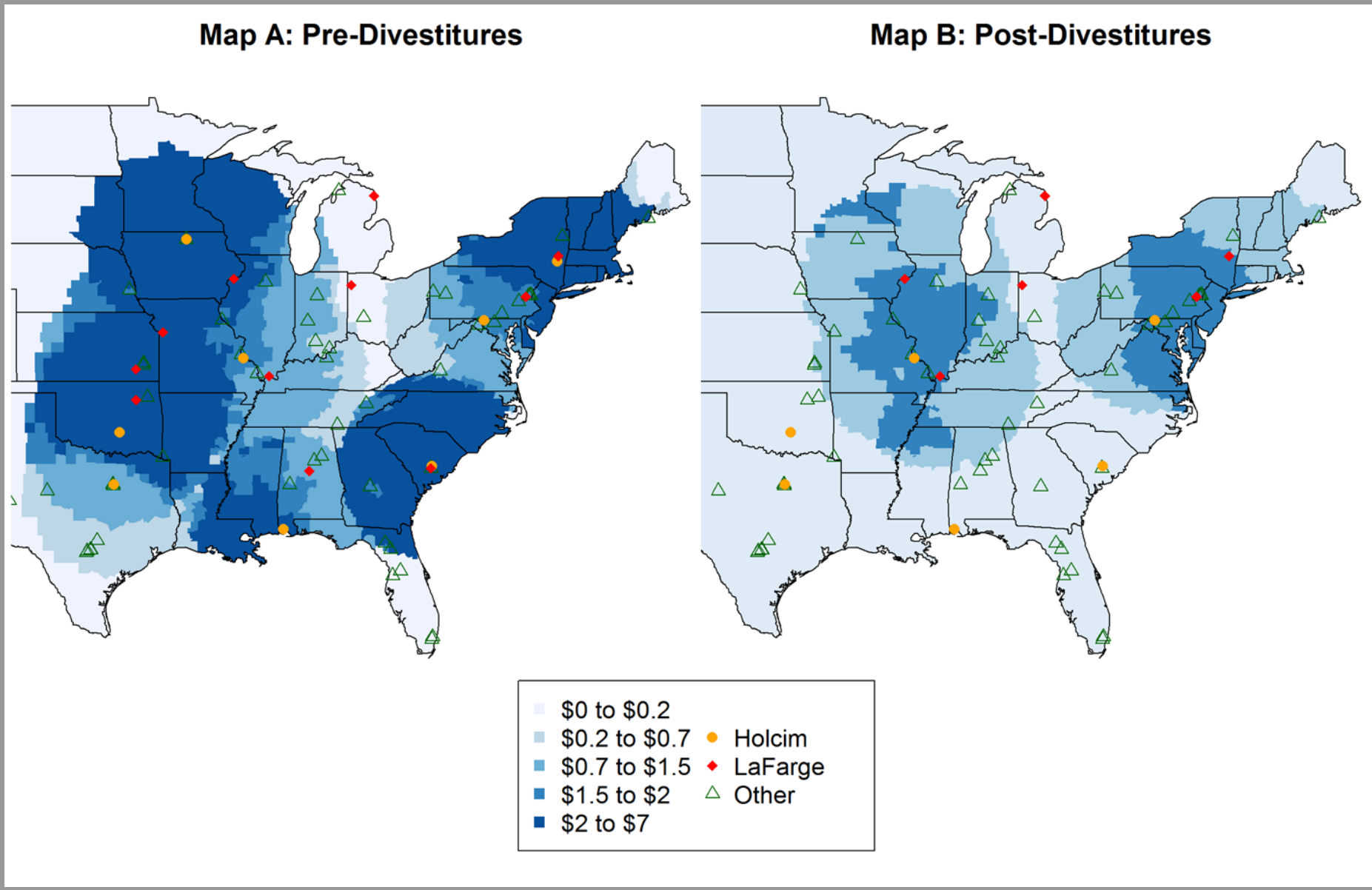
Map A: Pre-Divestitures
Map B: Post-Divestitures
$0 to $0.2
$0.2 to $0.7
$0.7 to $1.5
$1.5 to $2
$2 to $7
Holcim
LaFarge
Other

Who bears the burden of cap-and-trade?

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Under symmetric oligopoly, change in producer surplus equals

$$\frac{\partial \pi}{\partial t} = \left[\rho^M \left(1 - m\epsilon^D\right) - 1\right] Q$$

- ρ^M is industry pass-through; m is margin; ϵ^D is market demand elasticity
- $m\epsilon^D \in [0, 1]$ nests perfect competition, monopoly
- Obtain ρ^M from our results, cull $m\epsilon^D$ from literature

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- Broad disbursement of revenues is justifiable
- Conservative calculations

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