Passing Through the Supply Chain: LPG Tax in Brazil

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Agenda

Introduction

- **Context: Tax increase in the Brazilian LPG market.**
- **Two parts**:
  1. What is the pass-through along the supply chain?
  2. What does it reveal about market power and bargaining power?

Motivation

- Important to know how tax changes affect final consumers.
- How are taxes/subsidies passed on to final consumers?
- Concentrated industry $\rightarrow$ market power concerns.
- Welfare implications.

Literature Review & Contribution

- General theory: Weyl and Fabinger (2013)
- Theory on pass-through & vertical relationships: Adachi and Ebina (2014), Gaudin (2016)
- Empirical estimation of pass-through to say something about market power: Delipalla and ODonnell (2001), **?**, Cabral et al. (2018), Pless and Benthem (2019)
- **Contribution**: first empirical estimation of pass-through along the supply chain to say something about both market power and bargaining power
  - Looking at the overall pass-through only can be misleading when one wants to infer something about market power of different players along the chain

Part I: What is the pass-through along the supply chain?

- We assess the **effect of a state tax shock on LPG price**, considering the whole supply chain.
- We use a sudden change in the state tax in the state of Minas Gerais to identify the effect.
- **DD strategy**: Minas Gerais (treated) vs. bordering Federative Units (untreated), before vs. after the state tax shock.

Part II: What does it reveal about market/bargaining power?

- We look at the **theory**.
- We use different models for the distribution and retail markets.
- We estimate the **elasticity of demand**, using the state tax shock as an instrument for price.

The LPG Market

- Market for liquefied petroleum gas (LPG) cylinder in Brazil – the residential package type, used mainly as **fuel for cooking**.
- Enormous reach: over 95% of households in the country.
- Sensitive product: non negligible share on the budget of lower income families.
- Concentrated industry in the refineries' market[1] and the distributors' market[2].
- What about the retail market? Is it also concentrated?
- **Market power could seriously harm welfare.**

[1] Monopoly of Petrobras.

[2] Oligopoly formed by few large players.

The LPG Market

- Supply chain:

refineries $\rightarrow$ **distributors** $\rightarrow$ **retailers** $\rightarrow$ final consumers

- LPG Price:

refineries' price[3] + social contributions and social security related taxes[4] + state tax (ICMS) + **distributors' margin** + **retailers' margin**

[3] Determined by Petrobras.
[4] PIS/PASEP and COFINS.

The LPG Market

- Big discussion in Brazil about technical note number 151/2015 of *Superintendencia de Asbastecimento (SAB)*, which proposes prohibiting distributors to participate in the retail market
- Specialists argue that there is no economic foundation for such prohibition, because it is only optimal for distributors to participate in the retail market where it can take advantage of already established infrastructure
- **What about markets such as MG, where many distribution/packaging plants are established?**

Anticipating Results

- Overall **incomplete pass through to consumer price**.
- But...

Incomplete pass-through: distributors $\rightarrow$ retailers

Complete pass-through: retailers $\rightarrow$ final consumers

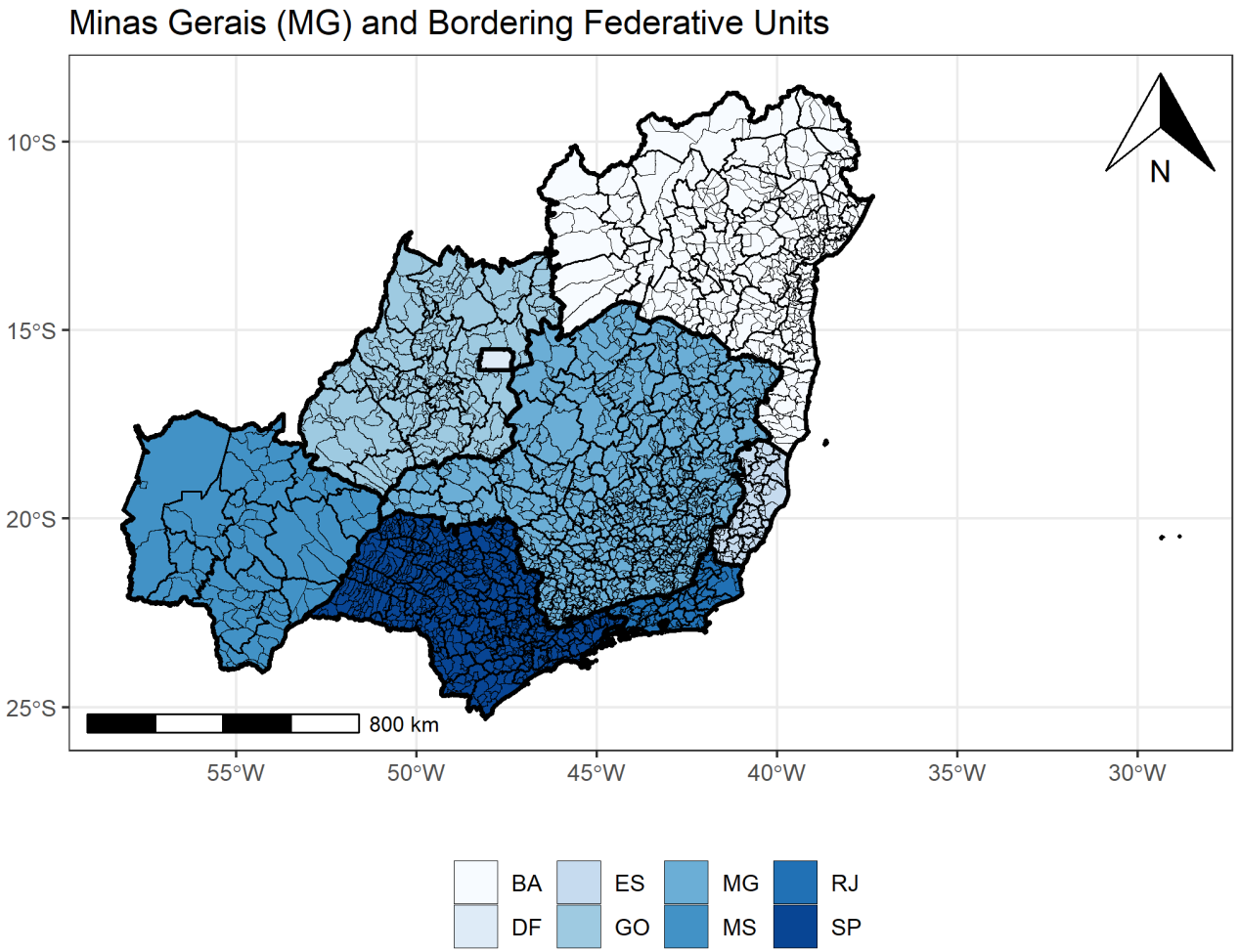
Data

- **ANP**:
  - Monthly data on state tax (2015-2018), retail price, retail margin, and distribution price per municipality – for a sample of municipalities taken for each state (2015-2017);
  - Quarterly data on quantity sold per municipality (2015-2017).
- **IBGE**: IPCA data[5]; municipality codes and corresponding microregions; and maps for identifying bordering and non-bordering municipalities[6].

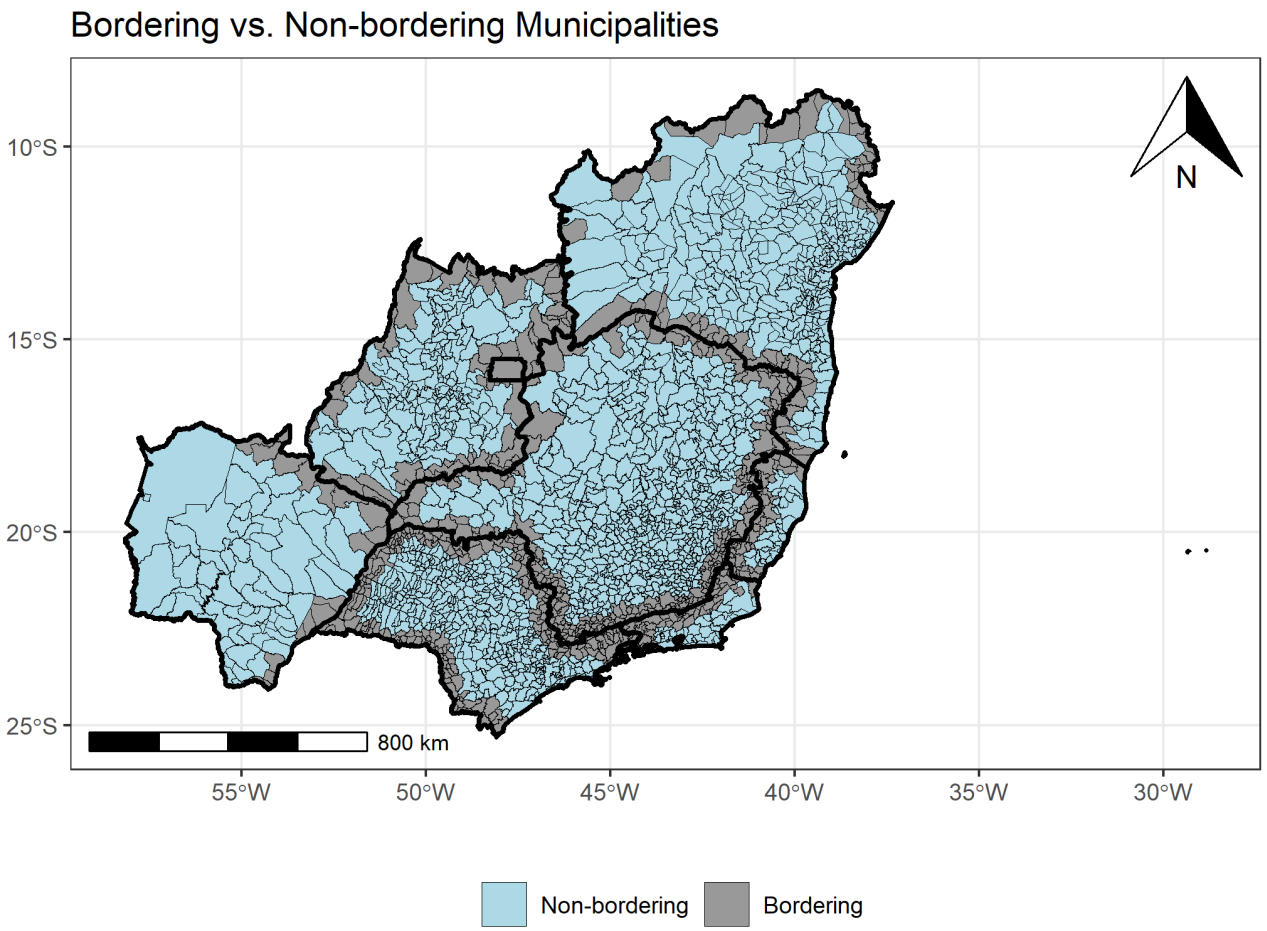
[5] For transforming nominal values into real values.

[6] We defined the centroid point coordinates of each municipality, calculated the municipality centroid distance from the border of its Federative Unit, and then defined the municipality as "non-bordering" if its centroid is located at least 40 km away from the border.

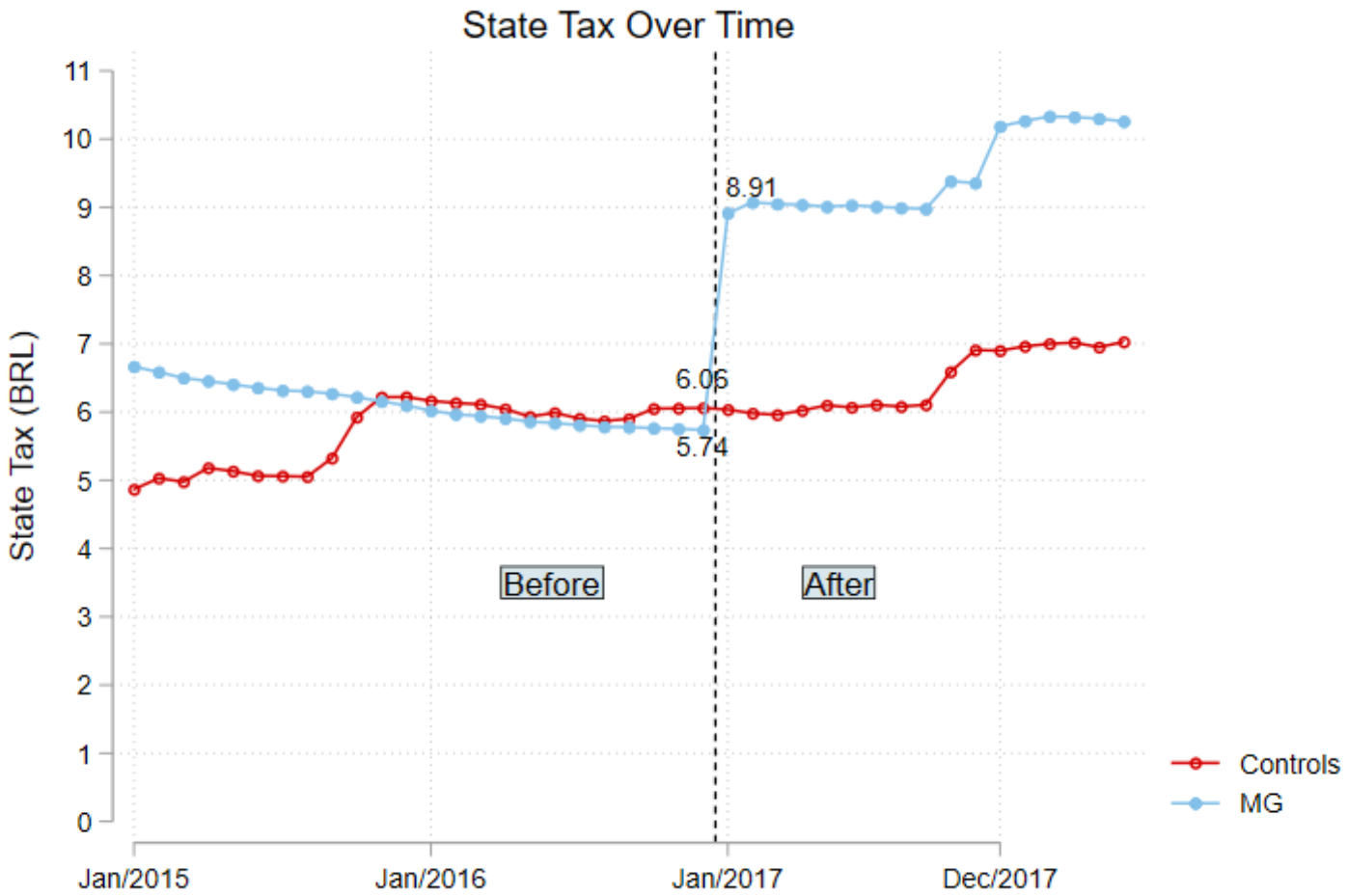
Data Visualization: Minas Gerais (treated) vs. bordering Federative Units (untreated)



Data Visualization: Bordering vs. Non-Bordering Municipalities



The Sudden State Tax Change in Minas Gerais



Average state tax shock in first semester of 2017: BRL 3.14

Pass-Through

Empirical Strategy

- **DD framework**, based on the state tax shock in MG.
- **Main identification assumption**: there are no factors that change over time differently for treated and non-treated municipalities (parallel trends).
- **Focus on non-bordering municipalities** because the bordering ones seem to violate the identification assumption.

Empirical Strategy

Regression Equation

$$Y_{imt} = \alpha + \beta T_{imt} + \delta_i + \phi_{mt} + u_{imt}$$

Where:

- Y_{imt}: price (or margin) in municipality i, month m, year t
- T_{imt}: dummy variable that takes the value of 1 if municipality i is treated in month m and year t (that is, if i is located in MG and the observation corresponds to January-2017 or later), and zero otherwise
- δ_i: represents municipality fixed effects
- ϕ_{mt}: represents month/year fixed effects
- **Note: analysis restricted to Jul-2016 up to Jun-2017**

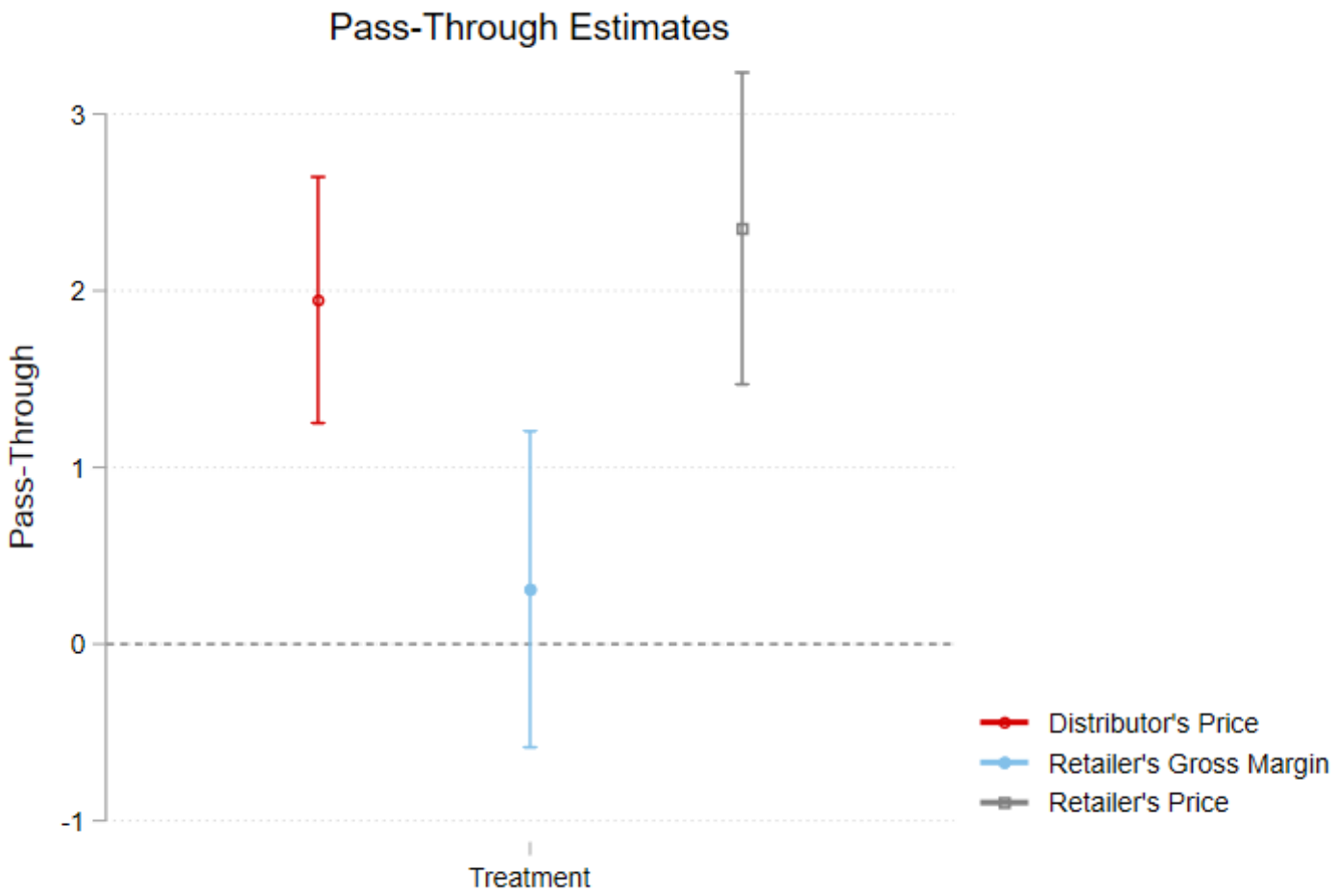
Results of the DD Model: Non-Bordering Municipalities

	Distributor Price	Retail Margin	Retail Price
State Tax	1.9472	.3099	2.3522
SE	.3482	.4472	.4412
p-value	0	.491	0
Constant	32.6748	13.8454	46.4092
SE	.0433	.0556	.0539
p-value	0	0	0
F-stat	31.27	.48	28.42
R2	.88	.77	.87
Adj R2	.87	.75	.86
N	2512	2511	2556

Sample restricted to non-bordering municipalities
Municipality FE: YES
Month/Year FE: YES
Additional Controls: NO

(refineries' price + social contributions and social security related taxes + state tax + distributors' margin) + **retailers' margin** = **retailer's price**

Results of the DD Model: Coefplot



Results of the DD Model: Testing Differences in Coefficients

	D Price vs R Price	D Price vs R Margin	R Price vs R Margin
Chi2	.793	5.921	32.256
p-value	.373	.015	0

Sample restricted to non-bordering municipalities
Municipality FE: YES
Month/Year FE: YES
Additional Controls: NO

The difference between the pass-through to the Distributor Price and the pass-through to the Retail Price is **not significantly different from zero**, suggesting that the pass-through in the retail market is equal to unity.

Pass-Through in the Retail Market: 2SLS Estimation

	Distributor Price (1st stage)	Retail Price (2nd stage)
State Tax	1.9472	
SE	.3482	
p-value	0	
Distributor Price		1.1633
SE		.1079
p-value		0
F-stat	31.27	116.32
R2	.88	-.42
Adj R2	.87	-.55
N	2512	2512

Sample restricted to non-bordering municipalities
Municipality FE: YES
Month/Year FE: YES
Additional Controls: NO

Pass-Through Estimates: Interaction with Distance to Closest Distribution Plant

	Distributor Price	Retail Margin	Retail Price
Treatment	1.1665	-.0433	1.2676
SE	.4724	.5717	.45
p-value	.0164	.9398	.0066
Distance * Treat	.0071	.0032	.0099
SE	.004	.0046	.0047
p-value	.0822	.4895	.0398
Constant	32.6754	13.8456	46.4092
SE	.0411	.0541	.0468
p-value	0	0	0
F-stat	17.26	.39	19.81
R2	.88	.77	.87
Adj R2	.87	.75	.86
N	2512	2511	2556

Sample restricted to non-bordering municipalities
Municipality FE: YES; Quarter/Year FE: YES
Additional Controls: NO

Non-Bordering vs. Bordering

	All	Non-Bordering	Bordering
State Tax	2.2373	2.3522	1.6857
SE	.3704	.4412	.547
p-value	0	0	.0042
Constant	46.3249	46.4092	46.0631
SE	.0423	.0539	.0487
p-value	0	0	0
F-stat	36.49	28.42	9.5
R2	.88	.87	.9
Adj R2	.87	.86	.89
N	3365	2556	809

Municipality FE: YES
Month/Year FE: YES
Additional Controls: NO

Something different happens in bordering municipalities.

Pass-Through Estimates

Using "State Tax" as Explanatory Variable

	Distributor Price	Retail Margin	Retail Price
State Tax	.622	.0981	.7487
SE	.1076	.1412	.1394
p-value	0	.49	0
Constant	29.1439	13.2887	42.1626
SE	.6527	.8568	.8442
p-value	0	0	0
F-stat	33.41	.48	28.84
R2	.88	.77	.87
Adj R2	.87	.75	.86
N	2512	2511	2556

Sample restricted to non-bordering municipalities
Municipality FE: YES
Quarter/Year FE: YES
Additional Controls: NO

Pass-Through Estimates: Interaction with Distance to Closest Distribution Plant

Using "State Tax" as Explanatory Variable

	Distributor Price	Retail Margin	Retail Price
State Tax	.3774	-.005	.4159
SE	.1451	.1786	.142
p-value	.0117	.9779	.0048
State Tax * Distance	.0022	.0009	.003
SE	.0012	.0014	.0014
p-value	.0703	.5118	.041
Constant	29.5543	13.4616	42.6999
SE	.6084	.8069	.6444
p-value	0	0	0
F-stat	18.07	.37	19.64
R2	.88	.77	.87
Adj R2	.87	.75	.86
N	2512	2511	2556

Sample restricted to non-bordering municipalities
Municipality FE: YES; Quarter/Year FE: YES
Additional Controls: NO

Robustness Check: Controlling for Diesel Prices

	Distributor Price	Retail Margin	Retail Price
State Tax	1.9496	.4133	2.4569
SE	.3287	.4291	.4267
p-value	0	.3393	0
Constant	30.0374	4.3463	33.9627
SE	7.4843	10.1685	12.0952
p-value	.0002	.6706	.0067
F-stat	12.01	2.2	18.24
R2	.88	.77	.87
Adj R2	.86	.75	.86
N	2771	2770	2816

Sample restricted to non-bordering municipalities
Municipality FE: YES
Month/Year FE: YES
Controls: Diesel Price & Diesel S10 Price

Results are robust to the inclusion of diesel prices as controls.

Robustness Check: Parallel Trends

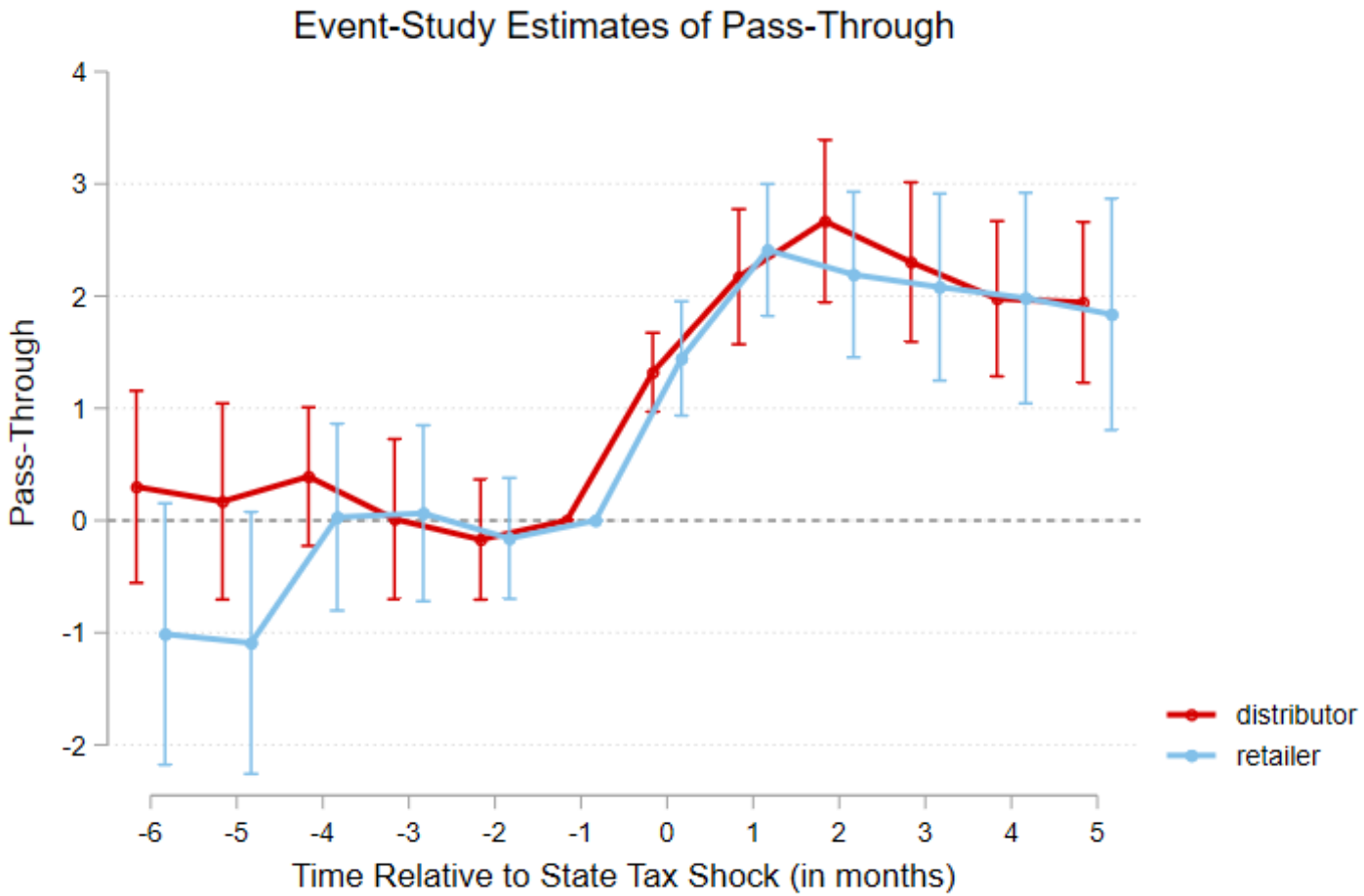
Non-Bordering Municipalities

Robustness Check: Parallel Trends

Non-Bordering Municipalities

Leads & Lags

Using observations from Jul-2016 up to Jun-2017



Sensitivity to the Definition of "Non-Bordering"

Distributor Price

	30 km	40 km	50 km	60 km	70 km
Treatment	1.9099	1.9472	1.8443	1.7904	1.9683
SE	.329	.3482	.342	.3712	.3761
p-value	0	0	0	0	0
Constant	32.626	32.6748	32.5411	32.6022	32.5409
SE	.0398	.0433	.0401	.045	.0477
p-value	0	0	0	0	0
F-stat	33.71	31.27	29.07	23.26	27.39
R2	.87	.88	.88	.88	.88
Adj R2	.86	.87	.87	.86	.87
N	2775	2512	2356	2128	1894

Sample restricted to non-bordering municipalities
Municipality FE: YES
Month/Year FE: YES
Additional Controls: NO

Results are robust to the using of different definitions of "non-bordering".

Sensitivity to the Definition of "Non-Bordering"

Retail Margin

	30 km	40 km	50 km	60 km	70 km
Treatment	.4042	.3099	.3537	.4674	.2977
SE	.4108	.4472	.4903	.5407	.539
p-value	.329	.491	.4736	.3911	.5831
Constant	13.9272	13.8454	13.9316	13.9291	14.0543
SE	.0498	.0556	.0575	.0656	.0683
p-value	0	0	0	0	0
F-stat	.97	.48	.52	.75	.31
R2	.77	.77	.77	.76	.75
Adj R2	.75	.75	.75	.74	.72
N	2774	2511	2355	2127	1894

Sample restricted to non-bordering municipalities
Municipality FE: YES
Month/Year FE: YES
Additional Controls: NO

Results are robust to the using of different definitions of "non-bordering".

Sensitivity to the Definition of "Non-Bordering"

Retail Price

	30 km	40 km	50 km	60 km	70 km
Treatment	2.403	2.3522	2.3097	2.3737	2.3146
SE	.4073	.4412	.4926	.531	.5194
p-value	0	0	0	0	0
Constant	46.4528	46.4092	46.355	46.4004	46.4678
SE	.0485	.0539	.0566	.0631	.0645
p-value	0	0	0	0	0
F-stat	34.8	28.42	21.99	19.98	19.86
R2	.87	.87	.87	.87	.86
Adj R2	.86	.86	.86	.85	.85
N	2820	2556	2400	2172	1932

Sample restricted to non-bordering municipalities
Municipality FE: YES
Month/Year FE: YES
Additional Controls: NO

Results are robust to the using of different definitions of "non-bordering".

Leave-One-Out Tests

Distributor Price

	Drop BA	Drop ES	Drop RJ	Drop SP	Drop MS	Drop GO	Drop DF
Treatment	1.9959	1.9637	1.9507	1.7486	1.9537	1.97	1.9472
SE	.3745	.3687	.361	.4161	.3495	.3677	.364
p-value	0	0	0	.0001	0	0	0
Constant	26.3645	30.798	30.855	30.8489	30.8354	30.8468	30.8331
SE	.2254	.1169	.1204	.1786	.0958	.1218	.1113
p-value	0	0	0	0	0	0	0
R2	.88	.88	.89	.9	.89	.84	.88
Adj R2	.87	.87	.88	.89	.88	.82	.87
N	2200	2404	2304	1457	2428	2380	2512

Sample restricted to non-bordering municipalities
Municipality FE: YES
Month/Year FE: YES
Additional Controls: NO

Leave-One-Out Tests

Retail Margin

	Drop BA	Drop ES	Drop RJ	Drop SP	Drop MS	Drop GO	Drop DF
Treatment	.263	.3537	.3767	.5089	.1881	.2766	.3099
SE	.4504	.4742	.4878	.5577	.4532	.4776	.4675
p-value	.5615	.4586	.443	.3661	.6796	.5646	.5099
Constant	14.4116	12.1706	12.1766	12.047	12.0736	12.0638	12.134
SE	.2852	.1929	.1911	.3081	.173	.1903	.1841
p-value	0	0	0	0	0	0	0
R2	.79	.77	.77	.79	.78	.73	.77
Adj R2	.77	.75	.75	.77	.76	.7	.75
N	2199	2403	2303	1457	2427	2379	2511

Sample restricted to non-bordering municipalities
Municipality FE: YES
Month/Year FE: YES
Additional Controls: NO

Leave-One-Out Tests

Retail Price

	Drop BA	Drop ES	Drop RJ	Drop SP	Drop MS	Drop GO	Drop DF
Treatment	2.3696	2.4091	2.4397	2.2966	2.2383	2.3397	2.3522
SE	.4494	.4683	.4836	.608	.4212	.4711	.4609
p-value	0	0	0	.0004	0	0	0
Constant	40.7222	42.9895	43.0455	42.9184	42.9308	42.9333	42.987
SE	.2454	.1636	.1681	.2388	.1573	.1642	.1554
p-value	0	0	0	0	0	0	0
R2	.87	.87	.87	.87	.88	.87	.87
Adj R2	.86	.86	.85	.86	.87	.86	.86
N	2220	2448	2340	1500	2472	2424	2556

Sample restricted to non-bordering municipalities
Municipality FE: YES
Month/Year FE: YES
Additional Controls: NO

Placebo Tests: Assigning Treatment to Non-Treated Units

Distributor Price

	BA	ES	RJ	SP	MS	GO	DF
Treatment	.3087	.2744	.0325	-.3516	.147	.3247	-.3516
SE	.3545	.4054	.404	.2341	1.4728	.2584	.2341
p-value	.388	.5016	.9362	.1394	.9209	.2147	.1394
Constant	32.308	32.3274	32.3333	32.4329	32.3319	32.3239	32.4329
SE	.0312	.0115	.023	.0651	.0326	.009	.0651
p-value	0	0	0	0	0	0	0
F-stat	.76	.46	.01	2.26	.01	1.58	2.26
R2	.89	.89	.89	.89	.89	.89	.89
Adj R2	.88	.88	.88	.88	.88	.88	.88
N	1899	1899	1899	1899	1899	1899	1899

Sample restricted to non-bordering municipalities
Municipality FE: YES
Month/Year FE: YES
Additional Controls: NO

Placebo Tests: Assigning Treatment to Non-Treated Units

Retail Margin

	BA	ES	RJ	SP	MS	GO	DF
Treatment	-.3001	.7743	.6259	.3487	-2.7421	-.479	.3487
SE	.7267	.4011	.4328	.394	1.7658	.3275	.394
p-value	.6815	.0593	.1544	.3803	.1268	.1498	.3803
Constant	13.3007	13.2523	13.2387	13.1775	13.335	13.291	13.1775
SE	.0639	.0114	.0246	.1094	.0391	.0114	.1094
p-value	0	0	0	0	0	0	0
F-stat	.17	3.73	2.09	.78	2.41	2.14	.78
R2	.76	.76	.76	.76	.76	.76	.76
Adj R2	.73	.73	.73	.73	.74	.73	.73
N	1898	1898	1898	1898	1898	1898	1898

Sample restricted to non-bordering municipalities
Municipality FE: YES
Month/Year FE: YES
Additional Controls: NO

Placebo Tests: Assigning Treatment to Non-Treated Units

Retail Price

	BA	ES	RJ	SP	MS	GO	DF
Treatment	.1002	1.0182	.7827	-.1017	-2.6204	-.1831	-.1017
SE	.7173	.4605	.2874	.4288	2.6741	.3524	.4288
p-value	.8895	.0316	.0089	.8134	.3319	.6057	.8134
Constant	45.5088	45.489	45.4738	45.5453	45.5745	45.5238	45.5453
SE	.0624	.0129	.0161	.1172	.0581	.012	.1172
p-value	0	0	0	0	0	0	0
F-stat	.02	4.89	7.42	.06	.96	.27	.06
R2	.84	.84	.84	.84	.84	.84	.84
Adj R2	.82	.83	.83	.82	.83	.82	.82
N	1932	1932	1932	1932	1932	1932	1932

Sample restricted to non-bordering municipalities
Municipality FE: YES
Month/Year FE: YES
Additional Controls: NO

Results for pass-through estimation

- Incomplete pass-through for distributors.
- Unitary pass through for retailers.
- Very robust to different specifications.
- Significant difference between border and non-border municipalities.
- Pass-through rate for distributors increase with distance to distribution centers. However, it is constant for retailers. (vertical integration of distributors near DCs).

Market Power & Bargaining Power

Recall the Results for **Non-Bordering** Municipalities...

Incomplete pass-through: distributors $\rightarrow$ retailers

Complete pass-through: retailers $\rightarrow$ final consumers

Industry Pricing Model

refinery $\rightarrow$ **distributors**: cost-plus price

1. **distributors** $\rightarrow$ **retailers**: bargain
2. **retailers** $\rightarrow$ **final consumers**: oligopoly

2- Theory: Pass-through in Symmetric Oligopoly; Weyl and Fabinger (2013); Miller et al. (2017)

$$\text{pass-through} = \rho = \frac{1}{1 + \frac{\theta}{\epsilon_\theta} + \frac{\epsilon_D - \theta}{\epsilon_S} + \theta(1 - E)}$$

- θ is a conduct parameter that summarizes market power[7]; usually, $\theta \in [0, 1]$[8]
- ϵ_θ summarizes how the conduct parameter changes with quantity
- E measures the demand curvature (it is the elasticity of the slope of the inverse demand function); this term is positive when demand is convex and negative when demand is concave[9] [10]

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[7] $\theta = \frac{p - mc}{p}\epsilon_D$

[8] θ can be greater than 1 when firms non-cooperatively price complementary goods.

[9] $E = \frac{-qp''(q)}{p'(q)}$

[10] Relationship between E and elasticity of demand: $\frac{\partial \epsilon}{\partial p} = \left(1 + \frac{1}{\epsilon} - E\right)\left(\frac{\epsilon^2}{p}\right)$

Theory: Pass-through in Perfect Competition

$$lim_{\theta \to 0}(\rho) = \frac{1}{1 + \frac{\epsilon_D}{\epsilon_S}}$$

- $\theta = 0$ when the market is competitive
- Burden held by the more inelastic side (supply vs. demand)
- **Perfectly inelastic demand or perfectly elastic supply give complete pass-through**
- A pass-through greater than unity cannot be explained in a competitive market

How can we explain $\rho = 1$ in a non-competitive market?

$$\rho = \frac{1}{1 + \frac{\theta}{\epsilon_\theta} + \frac{\epsilon_D - \theta}{\epsilon_S} + \theta(1 - E)}$$

- $\theta > 0$ if the market is not competitive
- Then, we need $\frac{\theta}{\epsilon_\theta} + \frac{\epsilon_D - \theta}{\epsilon_S} + \theta(1 - E) = 0$

Demand Analysis: IV model to measure elasticity

$$quantity_{iqt} = \beta_0 + \beta_1 \widehat{price}_{iqt} + \delta_i + \gamma_{qt} + u_{iqt}$$

$$price_{iqt} = \alpha_0 + \alpha_1 T_{iqt} + \delta_i + \gamma_{qt} + v_{iqt}$$

Where:

- $quantity_{iqt}$: quantity sold in municipality i and quarter q of year t
- $price_{iqt}$: retail price in municipality i and quarter q of year t
- T_{iqt}: dummy variable that takes the value of 1 if municipality i is treated in quarter q and year t
- δ_i and γ_{qt}: municipality fixed effects and quarter/year fixed effects
- u_{iqt} and v_{iqt}: error terms
- **Note: analysis restricted to Q3-2016 up to Q2-2017**

Demand Analysis: Various Specifications - First Stage

Using "treat" as explanatory variable

	Price	Log Price	Price	Price*Dist	Log Price	Log Price*Dist
Treatment	2.3522	.0454	1.2676	-169.0699	.025	-3.1202
SE	.2816	.0059	.407	73.747	.0086	1.5053
p-value	0	0	.0019	.0222	.0038	.0386
Treat*Dist	.	.	.0099	5.1915	.0002	.1001
SE	.	.	.0027	.49	.0001	.01
p-value	.	.	.0003	0	.0012	0
F-stat	69.78	58.33	42.27	87.45	34.9	79.08
R2	.9	.9	.9	1	.9	1
Adj R2	.87	.87	.87	.99	.87	1
N	852	852	852	852	852	852

Sample restricted to non-bordering municipalities
Municipality FE: YES; Quarter/Year FE: YES; Additional Controls: NO

Demand Analysis: Various Specifications - Second Stage

Using "treat" as explanatory variable

	Quantity	Log Quantity	Quantity	Log Quantity
Price	11431.95	.	2139.035	.
SE	26445.32	.	48858.95	.
p-value	.6657	.	.9651	.
Price Sq	.	.	.	.
SE	.	.	.	.
p-value	.	.	.	.
Price * Distance	.	.	54.6489	.
SE	.	.	187.4466	.
p-value	.	.	.7707	.
Log Price	.	-.4792	.	-.559
SE	.	.5543	.	1.0278
p-value	.	.3877	.	.5867
Log Price * Distance	.	.	.	.0005
SE	.	.	.	.0039
p-value	.	.	.	.906
N	852	852	852	852

Sample restricted to non-bordering municipalities
Municipality FE: YES; Quarter/Year FE: YES; Additional Controls: NO

Demand Analysis: Sensitivity to the Definition of "Non-Bordering"

Using "treat" as explanatory variable

	Log-Log 2nd Stage 30 km	Log-Log 2nd Stage 40 km	Log-Log 2nd Stage 50 km	Log-Log 2nd Stage 60 km	Log-Log 2nd Stage 70 km
Log Price	-.6962	-.4792	-.5229	-.395	-.0589
SE	.5152	.5543	.5727	.5907	.6362
p-value	.1771	.3877	.3616	.504	.9262
F-stat	1.83	.75	.83	.45	.01
R2	-.01	0	-.02	-.01	0
Adj R2	-.36	-.35	-.36	-.36	-.35
N	940	852	800	724	644

Sample restricted to non-bordering municipalities
Municipality FE: YES
Month/Year FE: YES
Additional Controls: NO

Demand Analysis: Leave-One-Out Tests

Using "treat" as explanatory variable

	Log-Log 2nd Stage Drop BA	Log-Log 2nd Stage Drop ES	Log-Log 2nd Stage Drop RJ	Log-Log 2nd Stage Drop SP	Log-Log 2nd Stage Drop MS	Log-Log 2nd Stage Drop GO	Log-Log 2nd Stage Drop DF
Log Price	-.4299	-.466	-.6459	-.3423	-.5303	-.3839	-.4792
SE	.5854	.5425	.5335	.7618	.5922	.5697	.5543
p-value	.463	.3907	.2265	.6535	.3709	.5007	.3877
F-stat	.54	.74	1.47	.2	.8	.45	.75
R2	0	0	-.02	-.01	0	0	0
Adj R2	-.34	-.35	-.36	-.36	-.35	-.34	-.35
N	740	816	780	500	824	808	852

Sample restricted to non-bordering municipalities
Municipality FE: YES
Month/Year FE: YES
Additional Controls: NO

Demand Analysis: IV model to measure elasticity

$$quantity_{iqt} = \beta_0 + \beta_1 \widehat{price}_{iqt} + \delta_i + \gamma_{qt} + u_{iqt}$$

$$price_{iqt} = \alpha_0 + \alpha_1 state\ tax_{iqt} + \delta_i + \gamma_{qt} + v_{iqt}$$

Where:

- $quantity_{iqt}$: quantity sold in municipality i and quarter q of year t
- $price_{iqt}$: retail price in municipality i and quarter q of year t
- $state\ tax_{iqt}$: state tax in municipality i and quarter q of year t
- δ_i and γ_{qt}: municipality fixed effects and quarter/year fixed effects
- u_{iqt} and v_{iqt}: error terms
- **Note: analysis restricted to Q3-2016 up to Q2-2017**

Demand Analysis: Various Specifications - First Stage

Using "state tax" as explanatory variable

	Price	Log Price	Price	Price Sq	Price	Price*Dist	Log Price	Log Price*Dist
Tax	.7453	.	-.0853	-107.055	.4138	-55.0674	.	.
SE	.0892	.	3.2008	312.3767	.1274	23.044	.	.
p-value	0	.	.9788	.7319	.0012	.0172	.	.
Tax Sq	.	.	.0558	12.391	.	.	.	.
SE	.	.	.215	20.9834	.	.	.	.
p-value	.	.	.7953	.5551	.	.	.	.
Tax*Dist	.	.	.	.	.003	1.6201	.	.
SE	.	.	.	.	.0008	.1498	.	.
p-value	.	.	.	.	.0003	0	.	.
Log Tax	.	.1057	.	.	.	.	.0613	-7.5404
SE	.	.0138	.	.	.	.	.0196	3.429
p-value	.	0	.	.	.	.	.0019	.0282
Log Tax*Dist	.	.	.	.	.	.	.0004	.2279
SE	.	.	.	.	.	.	.0001	.0221
p-value	.	.	.	.	.	.	.0017	0
F-stat	69.84	58.86	34.9	39.6	42.1	88.93	34.81	80.61
R2	.9	.9	.9	.9	.9	1	.9	1
Adj R2	.87	.87	.87	.86	.87	.99	.87	1
N	852	852	852	852	852	852	852	852

Sample restricted to non-bordering municipalities
Municipality FE: YES; Quarter/Year FE: YES; Additional Controls: NO

Demand Analysis: Various Specifications - Second Stage

Using "state tax" as explanatory variable

	Quantity	Log Quantity	Quantity	Quantity	Log Quantity
Price	4800.637	.	-1468648	-11219.52	.
SE	26385.74	.	968743.6	47080.54	.
p-value	.8557	.	.13	.8117	.
Price Sq	.	.	14198.93	.	.
SE	.	.	9319.249	.	.
p-value	.	.	.1281	.	.
Price * Distance	.	.	.	95.8219	.
SE	.	.	.	179.1204	.
p-value	.	.	.	.5929	.
Log Price	.	-.5492	.	.	-.6372
SE	.	.5528	.	.	.9686
p-value	.	.3209	.	.	.5109
Log Price * Distance	.	.	.	.	.0005
SE	.	.	.	.	.0036
p-value	.	.	.	.	.8859
N	852	852	852	852	852

Sample restricted to non-bordering municipalities
Municipality FE: YES; Quarter/Year FE: YES; Additional Controls: NO

How can we explain $\rho = 1$ in a non-competitive market?

$$\rho = \frac{1}{1 + \frac{\theta}{\epsilon_\theta} + \frac{\epsilon_D - \theta}{\epsilon_S} + \theta(1 - E)}$$

- Let us check whether this is the case here...
  - $|\epsilon_D| \approx 0 \Rightarrow E = 0$.
  - $\frac{1}{\epsilon_\theta} \leq 0$, usually assumed in standard models (Miller et al., 2017)
  - **For $\rho = 1$, we need that**: $\frac{\theta}{\epsilon_\theta} - \frac{\theta}{\epsilon_S} = 0$.
  - Hence,
    (i) $\epsilon_\theta = \epsilon_S$ or
    (ii) $\theta = 0$
  - Since $\epsilon_\theta < 0$ and $\epsilon_S \geq 0$, it must be that $\theta = 0$.
- **Retail market is most likely competitive!**

1-Theory: Pass-through and Bargaining, Gaudin (2016).

Nash bargaining:

$$\max_{p_D}\{[(p_D - c_D)q]^{\theta}[(p_R - c_R)q]^{1-\theta}\}$$

$$\text{pass-through} = \rho_D = \frac{(2-E)[1+(1-E)(1-\theta)]^2}{(2-E)^2[1+(1-E)(1-\theta)] - \theta^2 \frac{q}{q'}E'}$$

- θ is bargaing power; $0 \leq \theta \leq 1$
- E is the demand's curvature, or the elasticity of the slope of inverse demand
- E' tells how the demand curvature changes with price[11]

[11] $E' = \frac{\partial E}{\partial p} = \frac{q''}{q'}(1-2E) + \frac{qq'''}{q'^2}$

Pass-through and Bargaining: Results

- If $\theta = 0$ (i.e., the retailer has all the bargaining power), then:
  - $\rho_D = 1$ - **not our case**
- If $\theta = 1$ (i.e., the distributor has all the bargaining power), then:
  - the distributor pass-through is smaller (larger) than the retail one iff E increases (decreases) in price - **not our case**
  - both distributor and retail pass-through rates are equal iff demand curvature is constant (ex.: linear and iso-elastic demand forms) - **not our case**

- **In our case**, $\theta > 0$ and $\theta < 1$, because $E = 0$ (since $\epsilon_D = 0$)
- Calculating θ:
  $\rho_D = 0.62 = 1 - \frac{\theta}{2} \Rightarrow$
  $\theta = 0.76$
- **Thus, bargaining power is mostly held by distributors!**

Conclusion

- Overall incomplete pass-through.
- Pass-through lower than unity in distribution market. But increases with distance from distribution centers.
- Pass-through equal to unity in retail market, and not affected by distance from the distribution centers.
- Hence:
  - None of the two players, distributor and retailer, hold all bargaining power; however, the distributor holds most of it.
  - The results point to a competitive retail market.

Conclusion

- Demand estimation suggests near perfectly inelastic market demand, with high potential for market power exercise.
- Competition is indeed what limits market power at the retail level.
- Inelastic demand explains the complete pass through at the retail level.
- However, there is evidence of market power upstream on the supply chain, at the distributor level.
- This result is consistent with the concentrated oligopolistic industry structure, with 5 large firms.
- Evidence of vertical integration near distribution centers (see XXXX - report do setor?). It can explain more bargaining power for distributors near distribution centers.

Thank you.

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