The Heterogeneous Effects of Entry on Prices

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Motivation

Key dimension of consumer heterogeneity: **information**

- some consumers have **imperfect information** about product quality, prices etc.
- **Gasoline markets:** homogeneous products and price dispersion

Who benefits (more) from competition if

- *Informed* consumers observe and compare multiple prices
- *Uninformed* consumers only see one price

$\Rightarrow$ especially relevant in markets exhibiting **price dispersion**

This paper: causal relationship between competition (entry) and the price distribution in the German gasoline market

$\Rightarrow$ How does competition affect the value being informed?

Relevance

1. Policy Design

- policies affect number of firms and competition
  - e.g. merger control or removing entry barriers (deregulation)
- normative question: distributional implications of competition policy?
  - search costs vary with income (Nishida & Remer, 2018)
- Price dispersion ubiquitous even in homogeneous product markets
  - electricity & gas contracts, airline tickets, drugs
  - likely different weights on different consumer groups here

2. (Unintended) Consequences of Transparency Policies

- transparency policies lower search costs
- may or may not reduce prices on average
- larger gain from competition for informed consumers?
  - evidence for mechanism behind interaction of competition and transparency?

Strategy and Results at a Glance

Approach

1. **Within-station/-market** price distribution changes in response to entry nearby
2. Estimate **quantile treatment effects** of entry
3. Simulate **consumer decisions** to obtain effect on effective purchase prices

Results (for 1km radius markets)

1. Price **dispersion** increases by $\approx 30\%$
2. Entry effect **only at left tail of distribution**
   - Benchmark: $E(p) \downarrow 0.5$ct/l ($\approx 7\%$ of margin)
   - $\tau_{0.1} = -1.0$ct/l, $\tau_{0.5} = -0.5$ct/l, $\tau_{0.9} = 0.0$ct/l (FOSD)
3. Informed benefit more than uninformed (-1.0 ct/l vs. -0.7 ct/l)

Literature & Contribution

Heterogenous Effects of Competition:

- Allen et al. (2014): mergers in mortgage markets
- Lach & Moraga-Gonzalez (2017): cross-section in gasoline markets

Price and Quality Responses to Entry:

- Arcidiacono et al. (2020), Matsa (2011): Walmart
- Goolsbee & Syverson (2008), Prince & Simon (2015): Airlines
- Cardoso et al. (2022), Davis et al. (2022), Elliott et al. (2020), Koh et al. (2022): Gasoline

Heterogenous Policy Effects:

- Cengiz et al. (2019), Dube (2019), Finkelstein & McKnight (2008), Havnes & Mogstadt (2015), Hernaes (2017), Huebener et al. (2020): Others

Entry and Prices in Gasoline Markets

Gasoline & Entry Data

- *prices:* daily, real-time gasoline prices (at 5pm) from MTS-K via `tankerkoenig.de`
- *entries:* several hundreds of entry events ⏭ Map & Timing
  - entry = new station id's first operation
- *time period:* early 2015 to early 2020
- # *stations:* $\approx$ 15,000

Other Data

- *input prices:* region-level, daily wholesale prices from `Argus Media`
- *opening hours:* daily, station-level opening hours from `tankerkoenig.de`
- *traffic data:* hourly, traffic data for $\approx$ 2000 counters from `BASt`
- *county-level variables:* income, commuters, vehicles, ...
- *grid variables:* population from `RWI-Geo-Grid`

Why Gasoline Markets? - Again ...

Advantages of Setting

1. Many, 'treatments' in narrow markets
   - market definition follows literature (1km/2km radius) ⏩ Markets
   - suitable control groups without spillovers
2. Homogeneous product & substantial price dispersion
   - 2km markets averages: $VOI = 1.2$ct/l, $Range = 2.7$ct/l ($margin = 7.4$ct/l)
3. Primary response to entry likely via prices
   - no menu costs, no product differentiation
   - few other strategic variables: opening hours?
4. high-frequency data & within-station price variation
   - $\approx 25,000,000$ observations in station-date panel

Empirical Strategy

1. Benchmark: Standard Event Study Approach

$$Price_{it} = \alpha_i + \gamma_{st} + \sum_{\tau=\underline{\tau},\neq -1}^{\bar{\tau}} \beta_\tau 1[Entry]_{i,t-\tau} + \epsilon_{it} \tag{1}$$

2. Distributional Analysis (QTEs & Consumer Choice)

- Run (1) fitted for different unconditional quantiles

Identification

Exploits:

- *exact timing of entry*

DiD Assumptions:

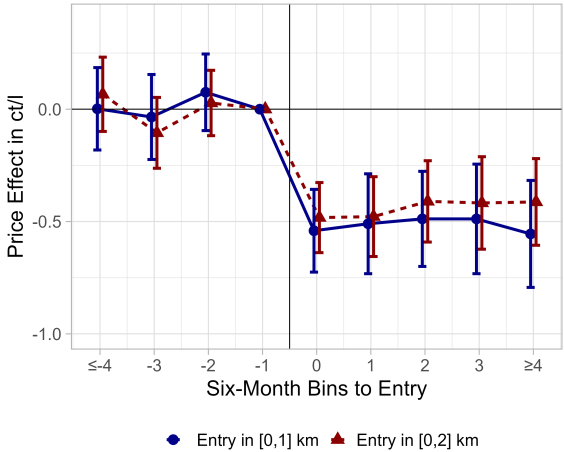
- Parallel trends assumption → visual inspection in event studies
- SUTVA → if at all: underestimation of price effects
- Staggered DiD → tackled ⏩ Sun & Abraham (2020)

Concerns:

- Reverse causality → should cause diverging pre-trends
- Other shocks at the same time? → county-level controls ⏩ Traffic Flows
- Alternative channels → opening hours ⏩ Opening Hours
- Persistence of shocks: no exit triggered, entrants' prices stable ⏩ Persistence

Effect of Entry on Prices

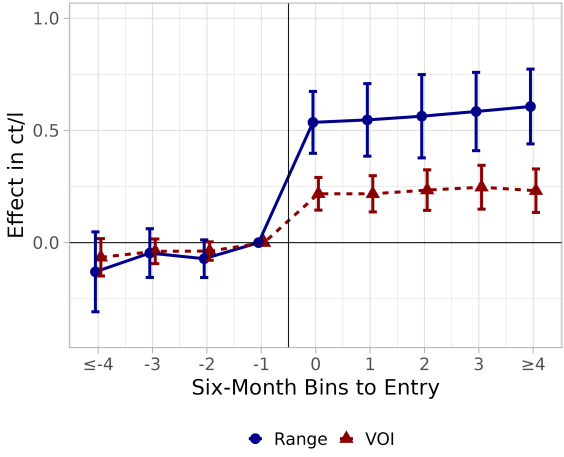
Standard Event Study Approach



⏩ ln(Margin) as Outcome ⏩ Heterogeneity

Dispersion

Market-Level Dispersion (1km Radius)



Distributional Analysis

- Unconditional quantile treatment effects

$$Y_{it} = \alpha_i + \gamma_{st} + \beta 1[Entry]_{it} + \epsilon_{it}$$

Firpo et al. (2009, Econometrica)

- Yields quantile treatment effects at κ^{th} quantile

$$Y_{it}(\kappa) = \quad q_\kappa + \frac{\kappa}{f(q_\kappa)} - \frac{1[Price_{it} < q_\kappa]}{f(q_\kappa)}$$

Chernozhukov et al. (2013, Econometrica)

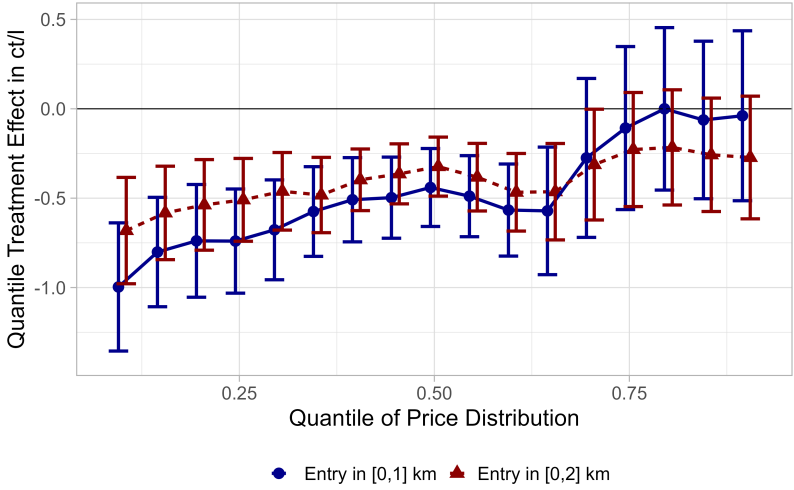
- distribution regressions for binary variable at all unique prices c

$$Y_{it}(c) = \quad 1[Price_{it} > c]$$

Cengiz et al. (2019)

Distributional Analysis

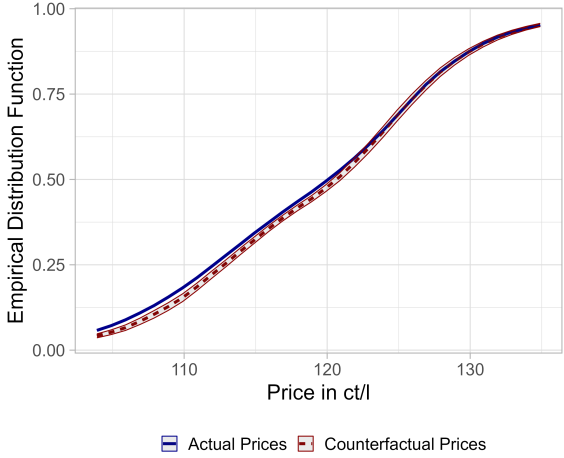
Firpo et al. (2009)



Sun & Abraham (2020) FEs Inference Time of Day

Distributional Analysis

Chernozhukov et al. (2013) - 1km Radius



2km Radius FOSD Tests

Conclusion

We show...

- that entry shifts the price distribution in a F.O.S.D. manner
- that price changes are strongest in the left tail

This implies...

- more competition has distributional implications
- that market transparency regulations benefits 'compliers'

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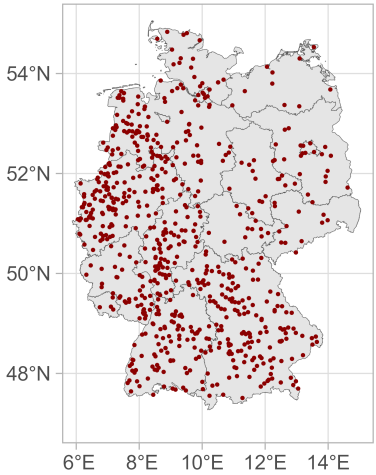
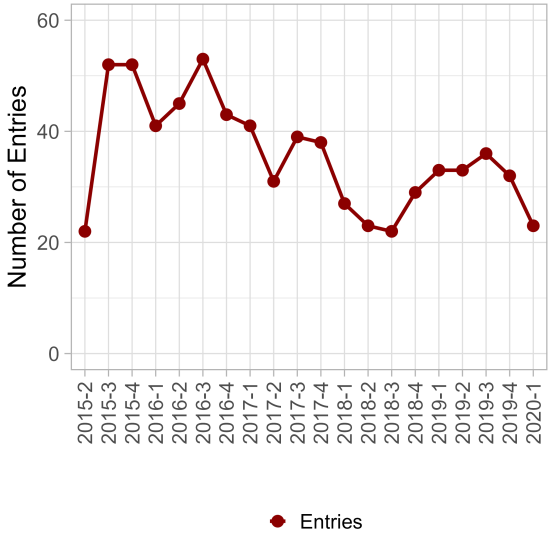
APPENDIX

APPENDIX: Entry in Gasoline Markets





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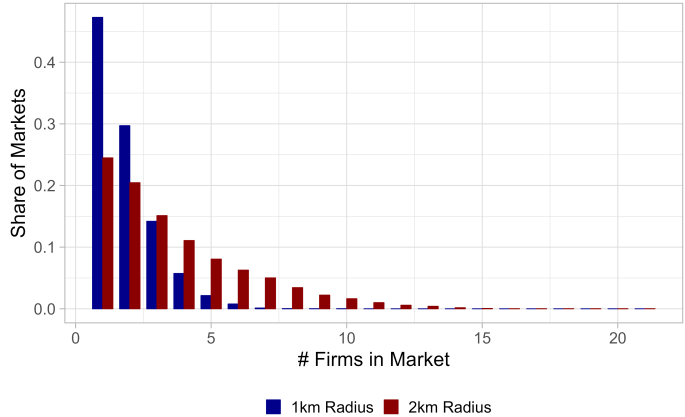

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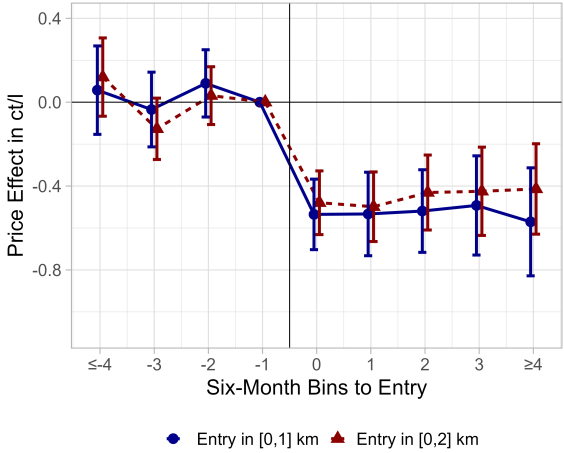
APPENDIX: Sun & Abraham (2020)

Staggered DiD Correction



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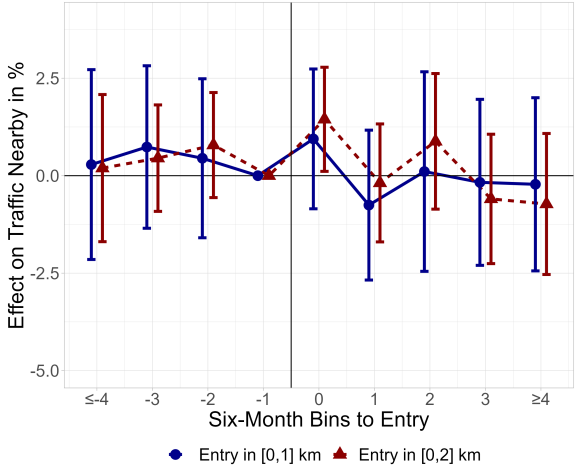
APPENDIX: Other Shocks

Traffic Changes



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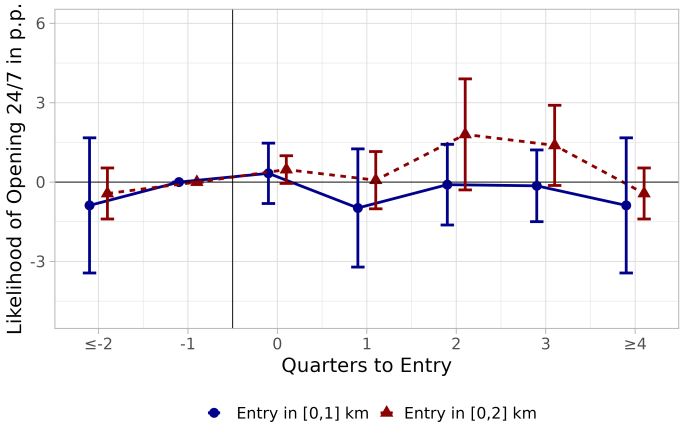
APPENDIX: Other Response Channels

Opening Hours



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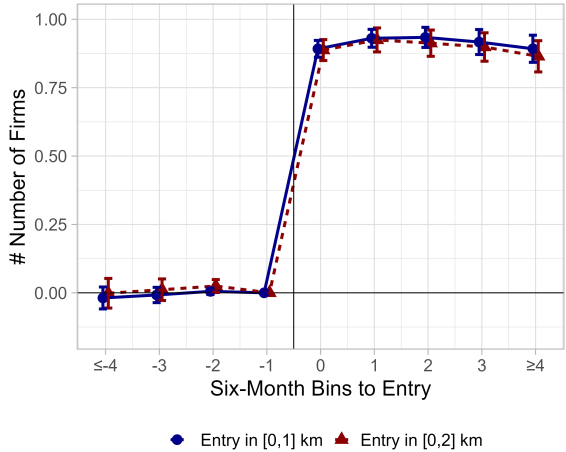
APPENDIX: Persistence of Treatment

Effect of Entry on # Firms



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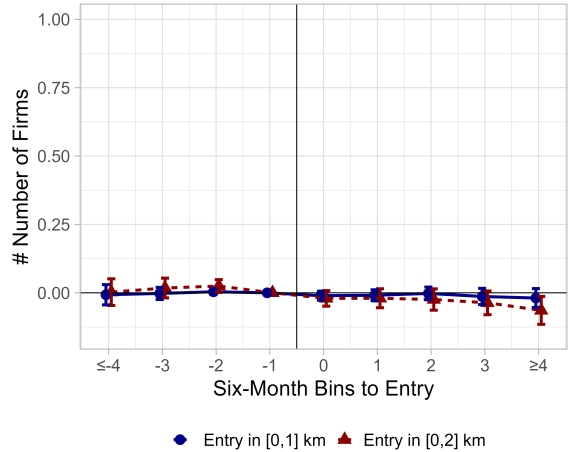
APPENDIX: Persistence of Treatment

Effect of Entry on # Incumbent Firms



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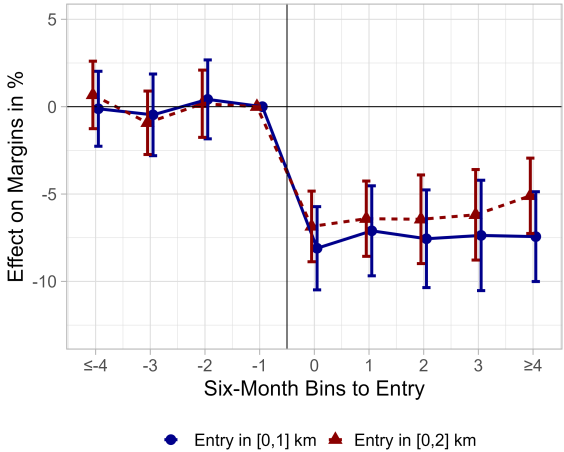
APPENDIX: Effect of Entry on Margins

Effect of Entry on ln(Margin)



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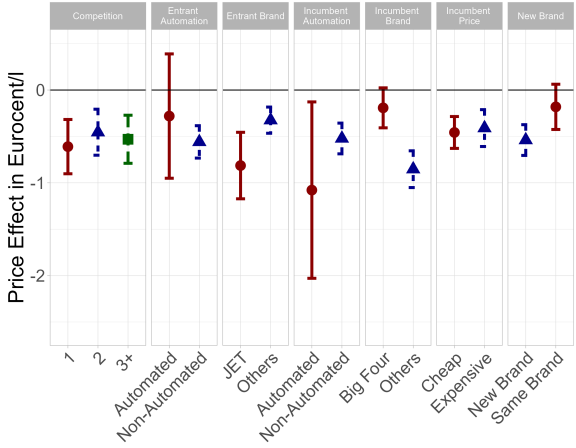
APPENDIX: Effect of Entry on Prices

Heterogeneity - 1km



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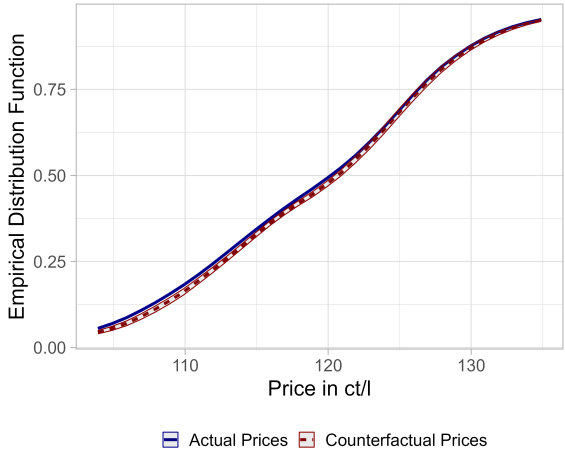
Market-Level Results: 2km Radius



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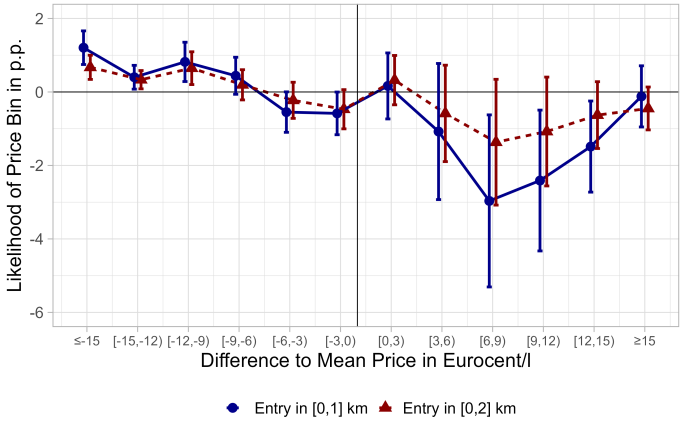
APPENDIX: Distributional Implications

Cengiz et al. (2019)

$$1[p \in bin]_{itb} = \alpha_i + \gamma_{st} + 1[Entry]_{it} + \epsilon_{it} \ \forall \ bin$$



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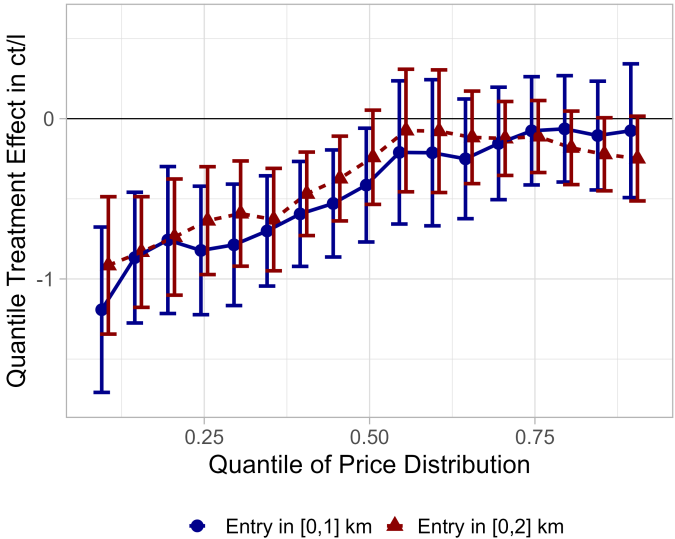
APPENDIX: Firpo et al. (2009)

Sun & Abraham (2020)



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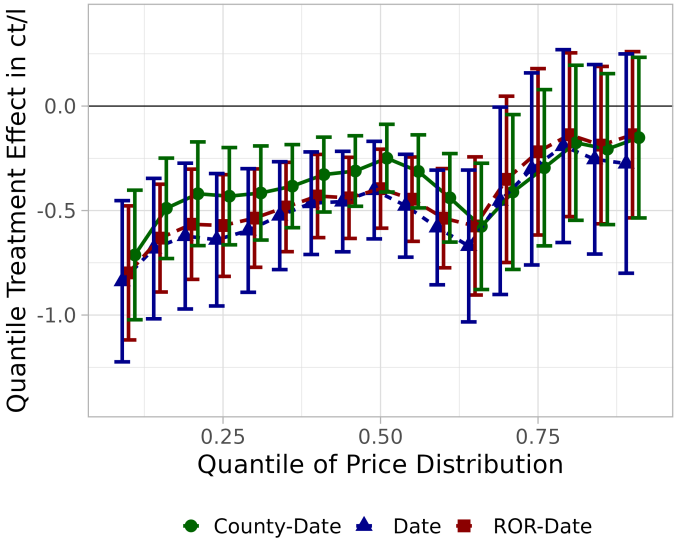
APPENDIX: Firpo et al. (2009)

Fixed Effects Variation



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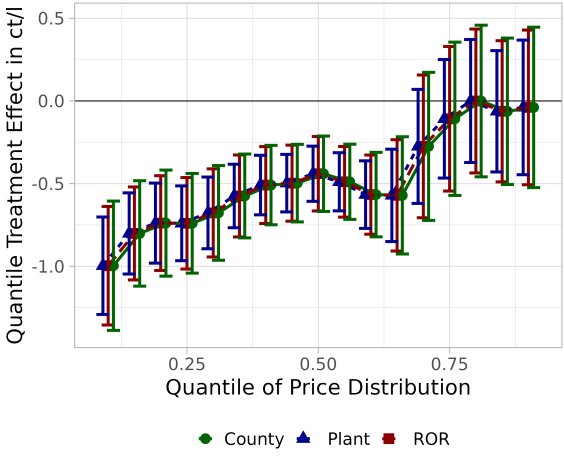
APPENDIX: Firpo et al. (2009)

Inference - 1km Radius



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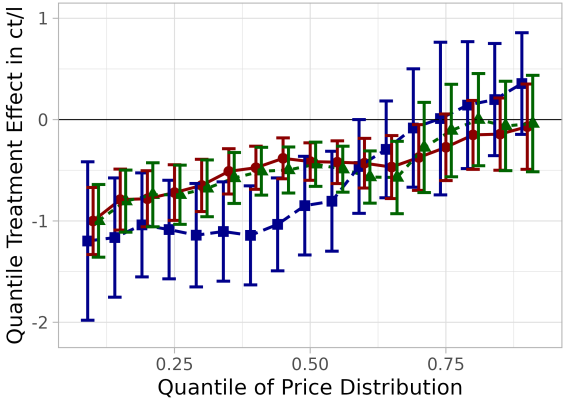
Data: Time of the Day



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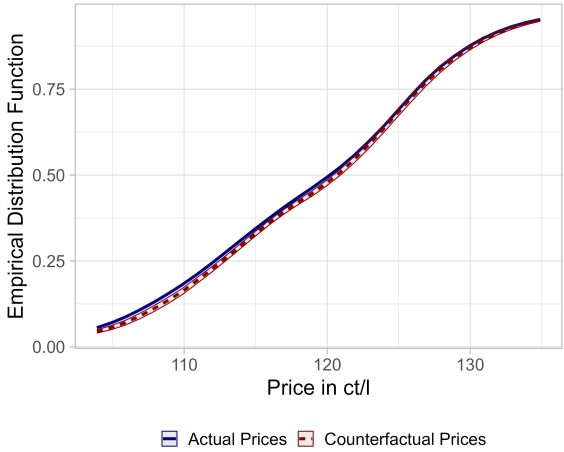
APPENDIX: Preliminary Results

Chernozhukov et al. (2013)

2km Markets



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APPENDIX: FOSD Tests

FOSD

	1km Radius		2km Radius	
	Test Statistic	p-value	Test Statistic	p-value
One-Sided KS-Test	0.0292	< 0.01	0.0201	< 0.01
Davidson & Duclos (2000)	$\in [-40.575, 0.915]$	-	$\in [-46.085, -8.633]$	-
Barrett & Donald (2003)	0.195	0.93	-	1

Note: We implement the FOSD test by Davidson & Duclos (2000) as done in Asplund & Nocke (2006). The tests differ in their assumption. The one-sided KS-Test only evaluates the maximum distance between actual and counterfactual distribution. Davidson & Duclos (2003) extend the comparison of both distribution to more than the point of maximum distance. Barrett & Donald (2003) smooth out the comparison by integrating over several points. Hence, the comparison can be interpreted as more continuous along the distributions. We evaluate the Davidson & Duclos (2000) approach as well as Barrett & Donald (2003) at ten prices in equal distance between 1.0 and 1.45 Euro/l. Barrett & Donald (2003) is the most demanding or "hardest to convince" test for FOSD as it takes the minimum distance between the two CDFs independent of how far the CDFs lie apart at all other points.

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APPENDIX: Distributional Analysis

Market-Level Results: 1km Radius