PASS-THROUGH AND COMPETITION

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Pass-through: why do we care?

Mergers and antitrust

- Efficiencies: benefit (passing-on) to consumers
- Price effects: incentive to raise price (to pass-on "upward pricing pressure")
- Vertical agreements: cost savings, elimination of double marginalization

Damages actions

- Passing-on defense: direct customer of cartelist to pass-on overcharge
- Passing-on offence: indirect customer of cartelist to be harmed by pass-on of overcharge

In general:

- Any counterfactual assessment of a policy intervention (regulation, state aid)
- Other: Tax incidence, exchange rate pass-through, opening up to trade

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Outline

1. Insights from economic theory

2. Evidence from empirical research

3. Competition and Pass-Through: some new evidence

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Pass-through: basic concepts

➢ **Absolute pass-through** is the degree to which a given absolute change in caused causes a given absolute change in price.

  ✓ If a €1 cost increase causes a €1 price increase: absolute pass-through equals 1 or 100%

  ✓ If a €1 cost increase causes a €0.5 price increase: absolute pass-through equals 1/2 or 50%

  ✓ If a €1 cost increase causes a €2 price increase: absolute pass-through equals 2 or 200%

➢ **Pass-through elasticity** gives the percentage increase in price arising from a 1% increase in cost.

  ✓ If the pass-through elasticity is 1, then 10% increase in cost leads to a 10% increase in price.

  ✓ If the pass-through elasticity is 0.5, then 10% increase in cost leads to a 5% increase in price.

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THE IMPACT OF A TAX OR SUBSIDY

● **specific tax**   Tax of a certain amount of money per unit sold.

Incidence of a Tax

P_b is the price (including the tax) paid by buyers. P_s is the price that sellers receive, less the tax.
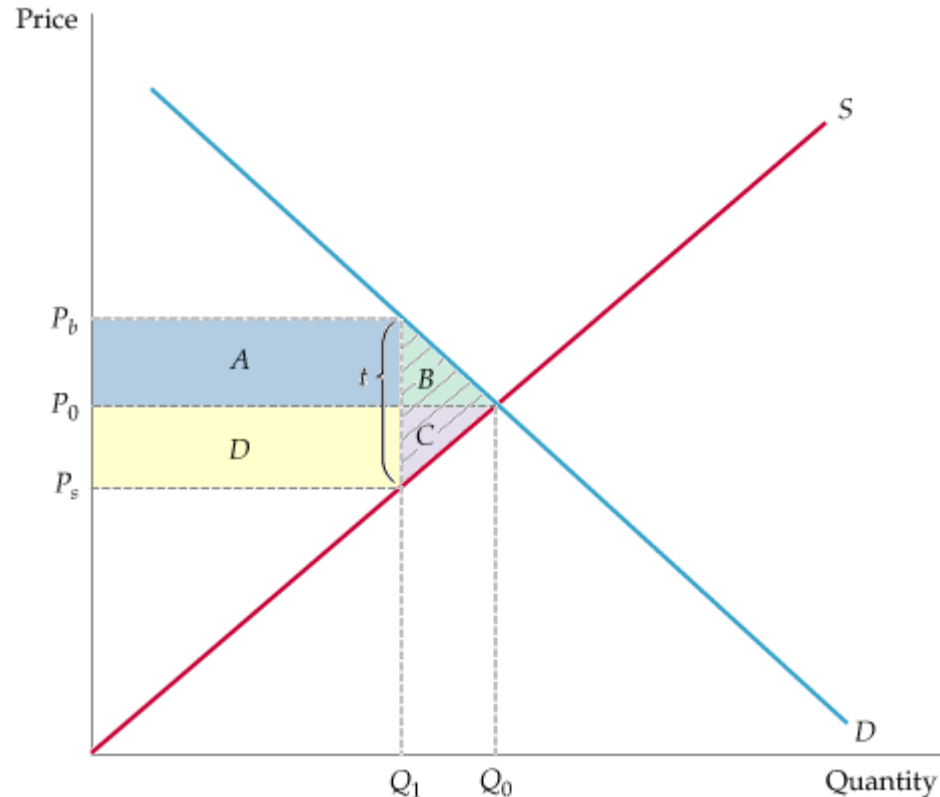
Here the burden of the tax is split evenly between buyers and sellers.

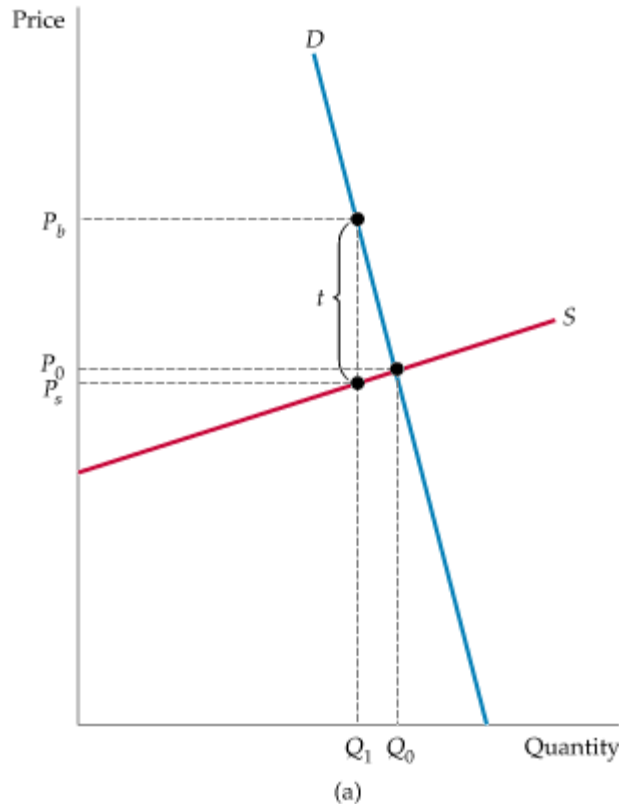Buyers lose $A + B$.

Sellers lose $D + C$.

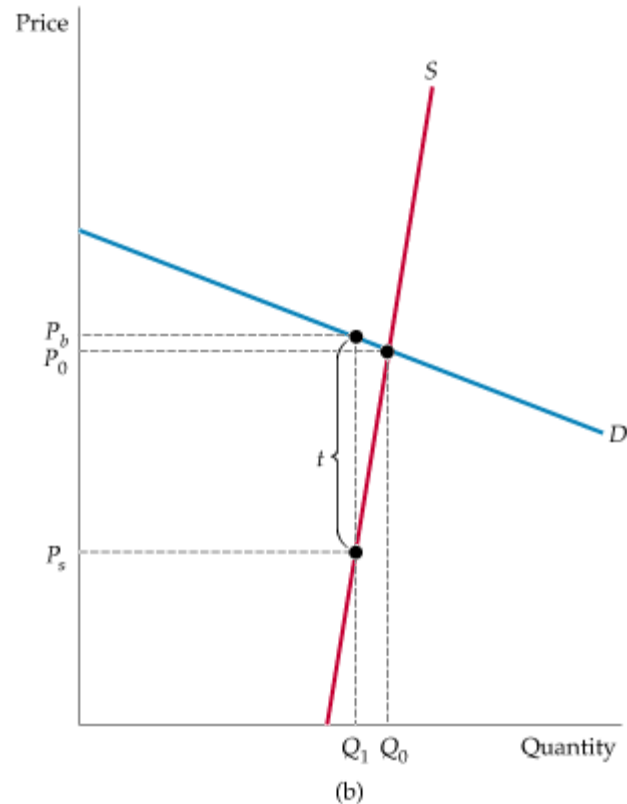The government earns $A + D$ in revenue.

The deadweight loss is $B + C$.

THE IMPACT OF A TAX OR SUBSIDY

Impact of a Tax Depends on Elasticities of Supply and Demand

(a) If demand is very inelastic relative to supply, the burden of the tax falls mostly on buyers.

(b) If demand is very elastic relative to supply, it falls mostly on sellers.

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Pass-through: tax incidence analogy

➢ The extent of (absolute) pass-through depends on the relative magnitudes of the slopes of demand and supply.

$$\rho = \frac{1}{1 + \dfrac{elasticity\ of\ demand}{elasticity\ of\ supply}} = \frac{1}{1 + \dfrac{\varepsilon_D}{\varepsilon_S}}$$

✓ If the elasticity of demand is large relative to the elasticity of supply, the pass-through rate would be low.

✓ If the elasticity of demand is small relative to the elasticity of supply, the pass-through rate would be high.

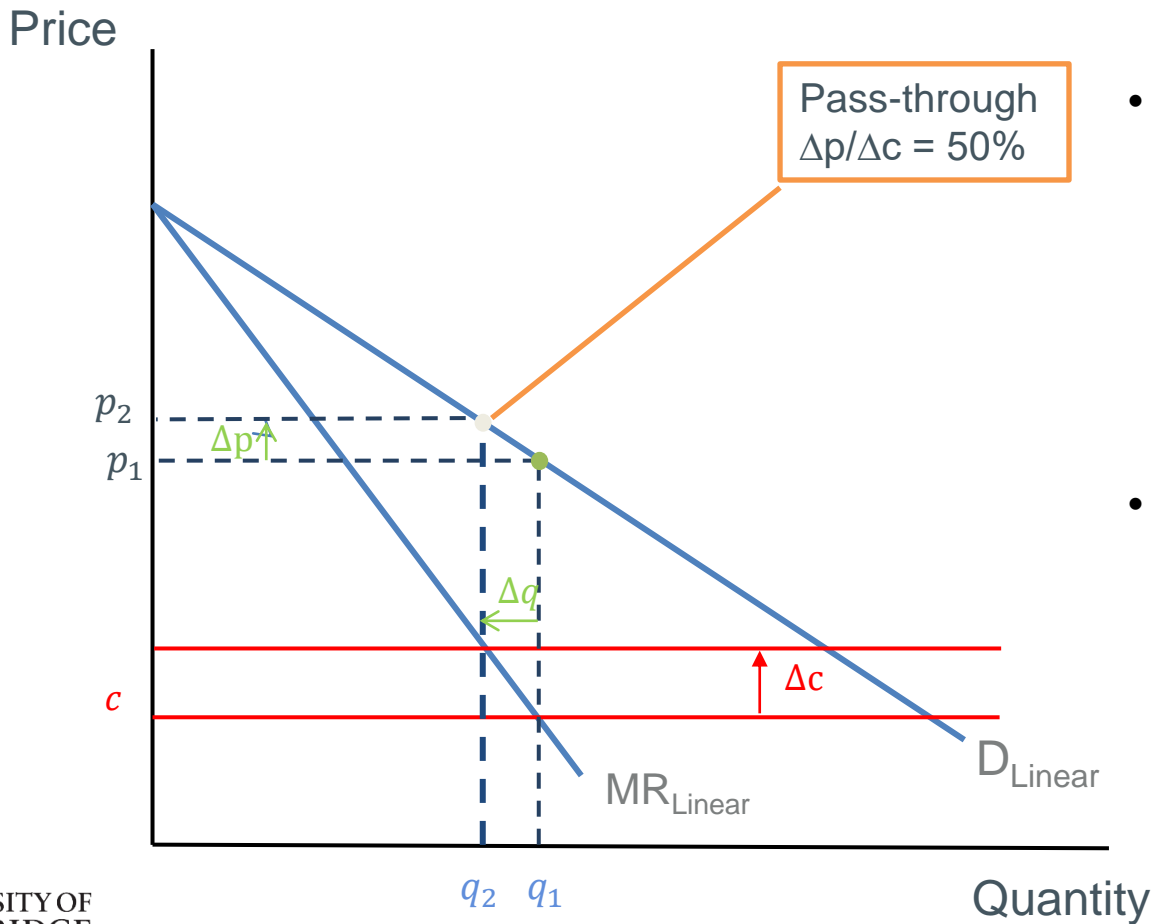➢ Identical outcome if the tax is imposed to firms or consumers!

Pass-through: perfect competition

➢ Industry-wide pass-through under perfect competition is:

$$\rho = \frac{1}{1 + \dfrac{elasticity\ of\ demand}{elasticity\ of\ supply}} = \frac{1}{1 + \dfrac{\varepsilon_D}{\varepsilon_S}}$$

✓ If industry supply is upward sloping and demand is downward sloping, equilibrium prices will increase by *less than* 100% even in the perfectly competitive scenario.

✓ The pass-through rate will decrease as demand becomes more elastic and/or supply become less elastic.

➢ Firm-specific pass-through will be 0 (atomistic price-takers).

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Pass-through: monopoly

Price

Pass-through
$\Delta p/\Delta c = 50\%$

p_2

Δp↑

p_1

Δq

c

Δc

D_{Linear}

MR_{Linear}

q_2 q_1

Quantity

- After a change in mc the monopolist re-optimizes.
- The extent of the required output adjustment, Δq, will depend on the slope of the marginal revenue curve.
- The increase in price, Δp, depends on the rate at which price increases as output contracts, i.e. the slope of the demand
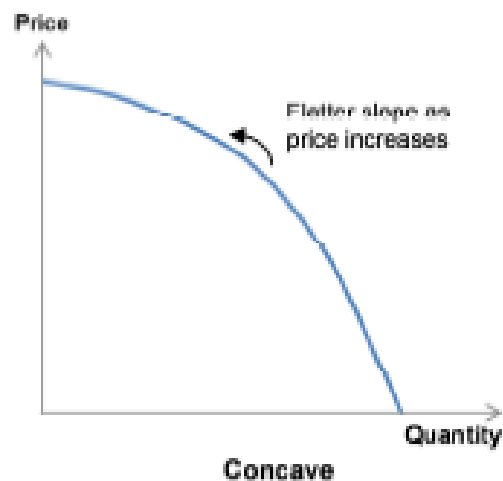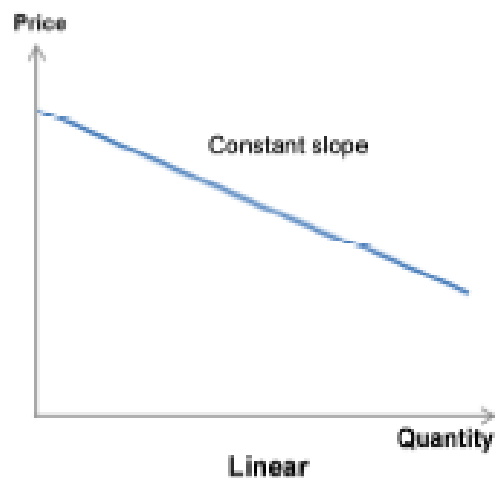
Pass-through: monopoly

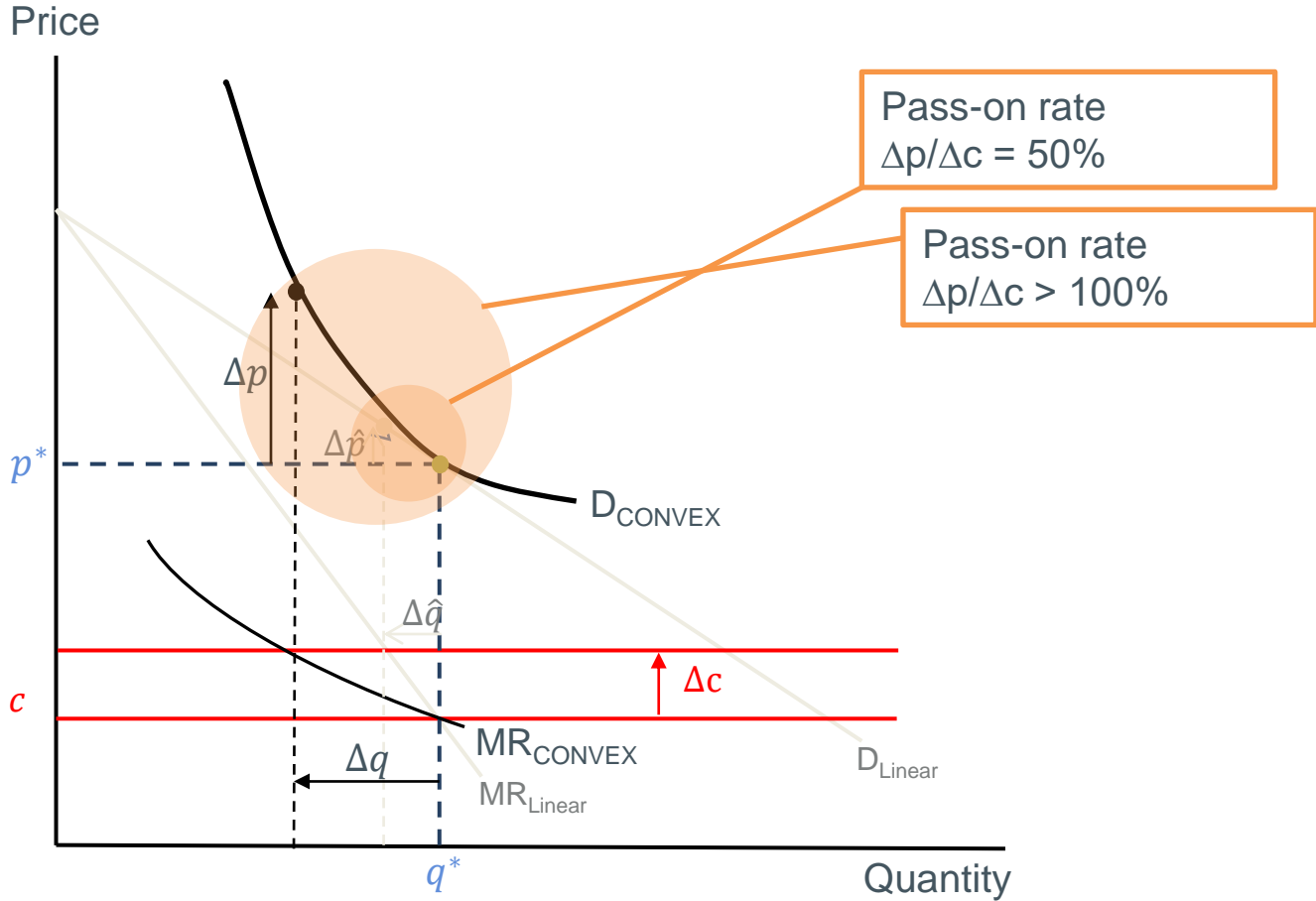➢ Pass-through under monopoly with constant marginal cost is:

$$\rho = \frac{slope\ of\ demand}{slope\ of\ marginal\ revenue}$$

$$= \frac{1}{2 + elasticity\ of\ slope\ of\ inverse\ demand}$$

✓ the elasticity of slope of inverse demand is the proportionate rate at which the slope of inverse demand changes as output is increased, so it captures the **demand curvature**.

➢ If D linear, curvature = 0, hence pass-through = ½.

➢ If D concave, pass-through smaller than the linear case.

➢ If D convex, pass-through can exceed 100% (over-shifting).

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Demand curvature and pass-through

Linear — Constant slope

Concave — Flatter slope as price increases

Convex — Steeper slope as price increases

Relevance of demand curvature: monopoly example

Pass-on rate
$\Delta p / \Delta c = 50\%$

Pass-on rate
$\Delta p / \Delta c > 100\%$

Price

Δp

$\Delta \hat{p}$

p^*

D_{CONVEX}

$\Delta \hat{q}$

Δc

c

MR_{CONVEX}

D_{Linear}

Δq

MR_{Linear}

q^*

Quantity

Pass-through: monopoly

➢ Pass-through under monopoly more generally is:

$$\rho = \frac{slope\ of\ demand}{slope\ of\ marginal\ revenue - slope\ of\ marginal\ cost}$$

- ▪ If MC slopes upwards, a contraction in output would lead to a reduction in MC as well as an increase in MR. Hence, smaller reduction in output will be needed.

$$= \frac{1}{1 + \dfrac{\varepsilon_D - 1}{\varepsilon_S} + \dfrac{1}{\varepsilon_{ms}}}$$

- ✓ $\varepsilon_D - 1$ essentially because price>mc
- ✓ ε_{ms} is the elasticity of the inverse marginal consumer surplus and provides a measure of demand curvature

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Pass-through: oligopoly

➢ Industry-wide pass-through under symmetric oligopoly is:

$$\rho = \frac{1}{1 + \dfrac{\theta}{\varepsilon_\theta} + \dfrac{\varepsilon_D - \theta}{\varepsilon_S} + \dfrac{\theta}{\varepsilon_{ms}}}$$

✓ θ is the conduct parameter (0 perfect competition – 1 monopoly)

✓ $\varepsilon_D - \theta$ essentially because price>mc

✓ ε_{ms} is demand curvature

➢ Asymmetric oligopoly: same ideas, more complicated formula

➢ Firms specific pass-through is *less* than industry specific

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Pass-through and Vertical Relationships

➢ Vertical relationship and vertical contractual restraints necessitates an analysis between "upstream" and "downstream" firms along the vertical chain of production.

➢ In general:

$$overall\ pass-through$$
$$= upstream\ pass-through \times downstream\ pass-through$$
$$= \rho_U \cdot \rho_D = \rho^2$$

➢ The overall pass-through will be less than upstream pass-through if $\rho < 1$ (cost absorbing scenario), or greater than upstream if $\rho > 1$ (cost amplification scenario).

➢ Vertical integration pass-through would be ρ.

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Quantitative evidence on Pass-through

➢ Large literature in international economics and macro looking at exchange rate pass-through, typically elasticity < 1

- Local distribution costs drive a wedge between import costs and prices

- Demand is not highly convex

- Multinational firms' ability to source inputs from different countries

➢ Wide range of pass-through rates across industries

➢ Even for the same industry-wide cost change, individual firms adjust their prices at different rates.

➢ Firm-specific pass-through smaller to industry-wide pass-through

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Quantitative evidence on Pass-through

❖ What about market power? Mixed results

  ✓ Alm, Sennoga and Skidmore (2009) find a lower pass-through in rural (less competitive) than in urban (more competitive) gasoline markets in the US.

  ✓ Doyle and Samphantharak (2008) and Stopler (2017) find that greater brand concentration and market power are associated with larger pass-through rates in the gasoline market.

❖ Competition = firms located within a given geography

❖ But firm location endogenous! Entry literature in IO.

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Pass-through and Competition

➢ Understanding how firms pass cost shocks through to prices of fundamental importance across many fields

  ✓ Public economics, international trade, productivity, IO (price discrimination, merger analysis, sectors: health, energy), macro (fiscal & monetary transmission)

➢ Theory: competition is a key determinant of pass-through

➢ Empirics: well-established research exploiting variability in costs (sales taxes, exchange rates, input prices) to infer the magnitude of the pass-through

➢ However, very little evidence how pass-through varies with competition

➢ Typically, number of competitors "located" nearby (arbitrary and problematic) with no attention to *market structure endogeneity*

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This paper

❖ Think of the ideal experiment:
- exogenous variation in market size,
- significant and unexpected common shock, and,
- good control for local market conditions (no way!)

❖ Welcome to Greece: where the impossible becomes reality!
- ✓ Islands of different size (given by the God(s))
- ✓ Financial crisis forces the government to raise taxes (three times!)
- ✓ Government increases excise duty for all gasoline products *except* for heating diesel (deep down they are randomistas…)

❖ Our goal: measure how pass-through varies with competition in small isolated oligopolistic markets of different size
- Heterogeneity across products (Unleaded 95 vs 100 vs Diesel)?
- Different tax changes (three different changes in excise duties)?
- Speed of adjustment?
- Alternative market definitions?

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Theory

Discussion based on Weyl and Fabinger (2013):

- Symmetric firms & perfect competition: $\rho = \dfrac{1}{1+\frac{\varepsilon_D}{\varepsilon_S}}$

- Monopoly : $\rho = \dfrac{1}{1+\frac{\varepsilon_D-1}{\varepsilon_S}+\frac{1}{\varepsilon_{ms}}}$

- Symmetric imperfect competition: $\rho = \dfrac{1}{1+\frac{\theta}{\varepsilon_\theta}+\frac{\varepsilon_D-\theta}{\varepsilon_S}+\frac{\theta}{\varepsilon_{ms}}}$

- Asymmetric: same ideas, more complicated formula

- In general, the sign and magnitude of ↑ competition on pass-through is ambiguous.

- If $\begin{cases} mc\ constant \\ \ \theta\ constant \\ demand\ linear \end{cases}$ then $\rho = \dfrac{1}{1+\theta}$ as competition ↑, pass-through ↑

Industry background

❖ Petroleum industry: refineries→ wholesalers → retailers

❖ Taxation of petroleum products:

$$P_{retail} = (P_{refinery} + taxes\&fees + margins)(1 + VAT)$$

❖ Financial/debt crisis: significant increase in excise duties

TABLE 1 - EXCISE DUTY TAX CHANGES (€ cents per litre and Δ%)					
Type of energy product	(1) Unleaded 95	(2) Unleaded 100	(3) Diesel	(4) Super (leaded)	(5) Heating oil
before	41	41	30.2	42.1	2.1
10-Feb-10	53	53	35.2	54.1	2.1
	(29%)	(29%)	(17%)	(29%)	(0%)
04-Mar-10	61	61	38.2	62.1	2.1
	(15%)	(15%)	(9%)	(15%)	(0%)
03-May-10	67	67	41.2	68.1	2.1
	(10%)	(10%)	(8%)	(10%)	(0%)

❖ <u>No change</u> in excise duty for <u>heating oil</u> (chemically identical to diesel, just colored): <u>control group</u>

Data

❖ Daily station-level retail prices for all available gasoline products across Greek islands in 2010 from the Ministry of Development & Competitiveness (e-prices.gr)

❖ Socio-economic (education, income, tourists etc) and geographic (size, distance from Piraeus/land) characteristics of each island from the Hellenic Statistical Authority

❖ Geo-located each gas station and calculated distances
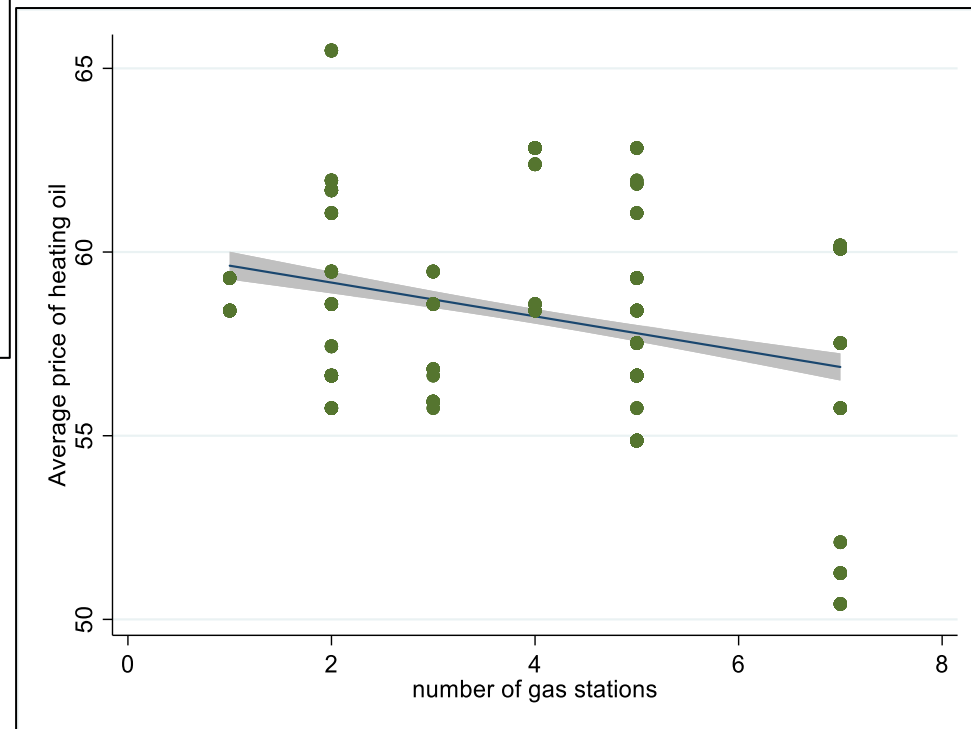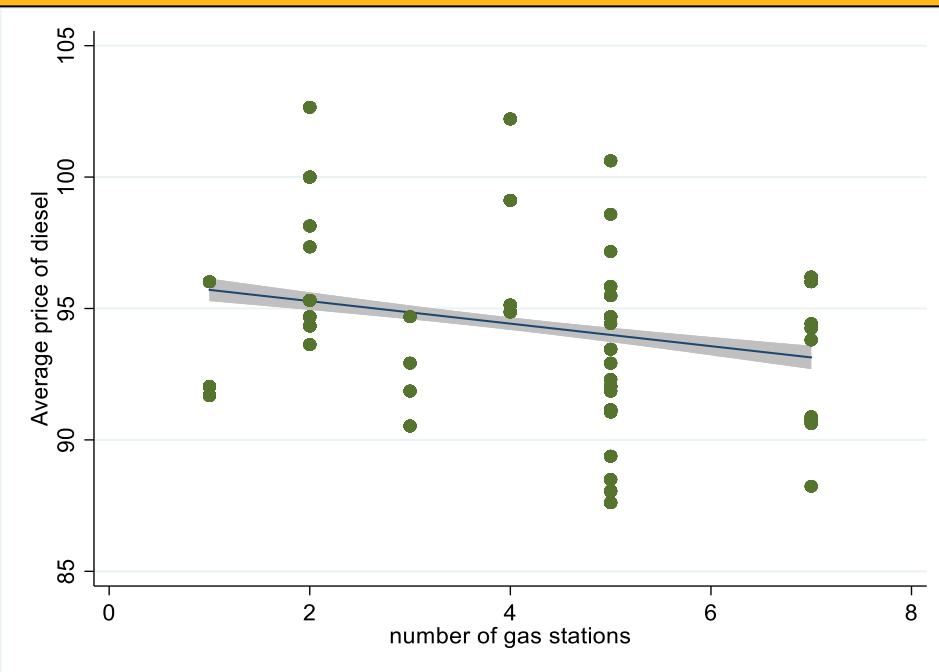
❖ Key: isolated markets with captive consumers

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Greek islands

Competition and Market Size

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Competition and Prices

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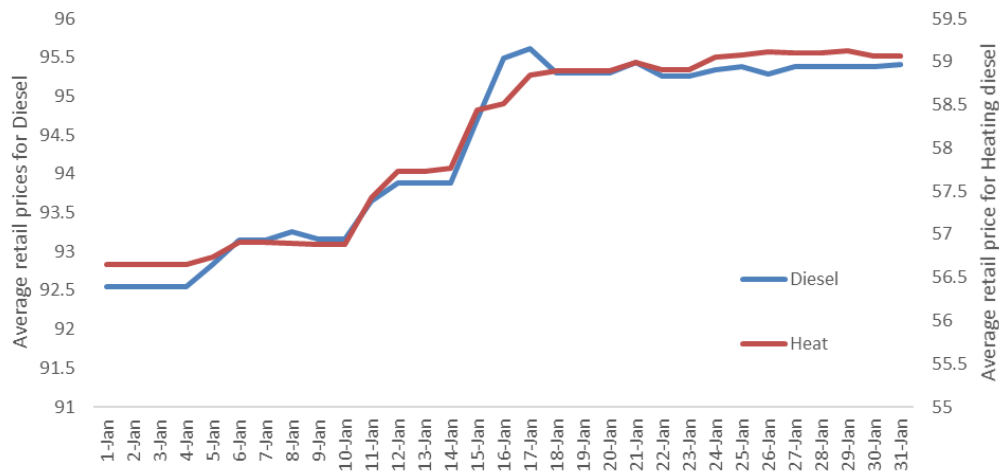Judge Business School
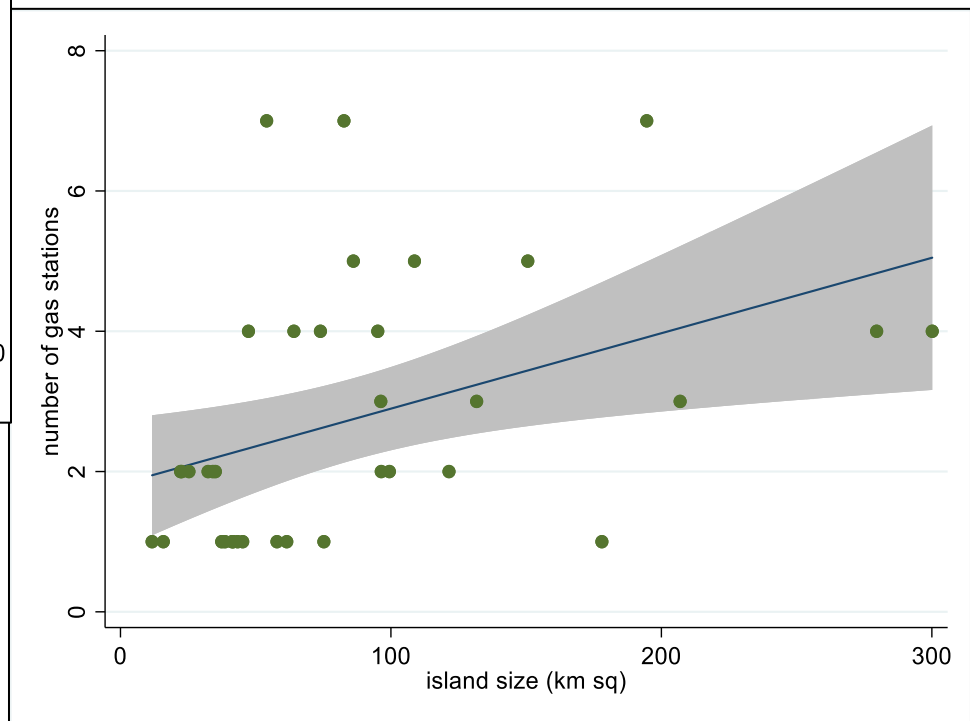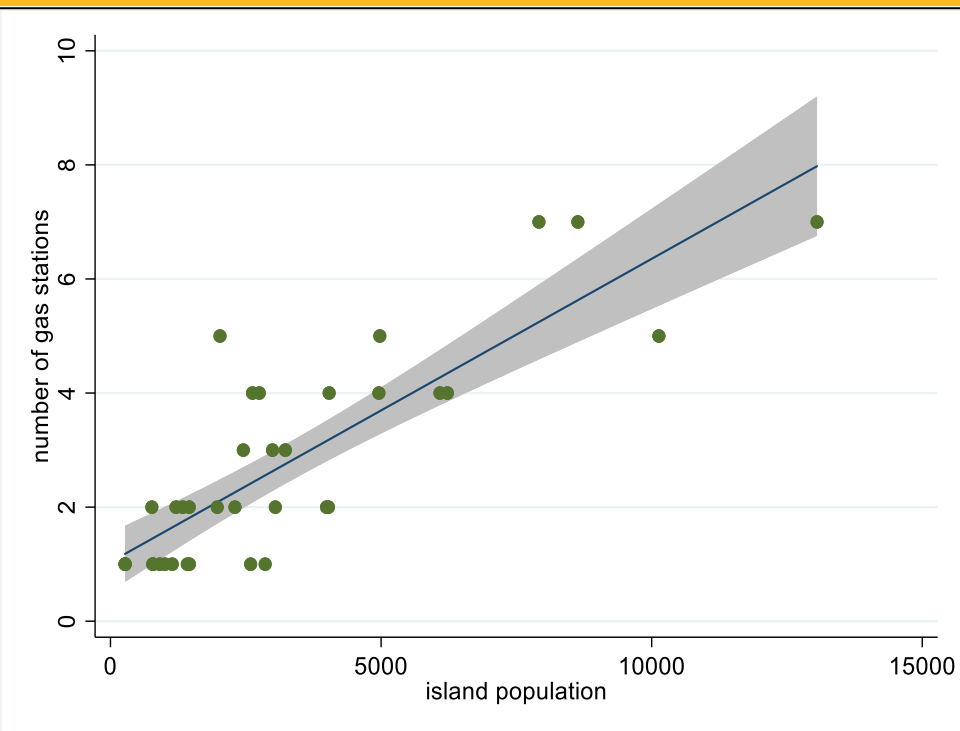
Methodology

- Difference-in-Differences framework:

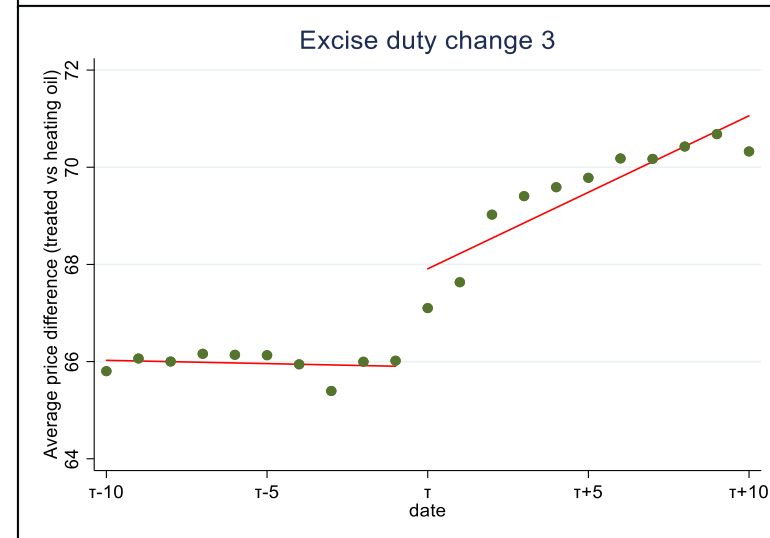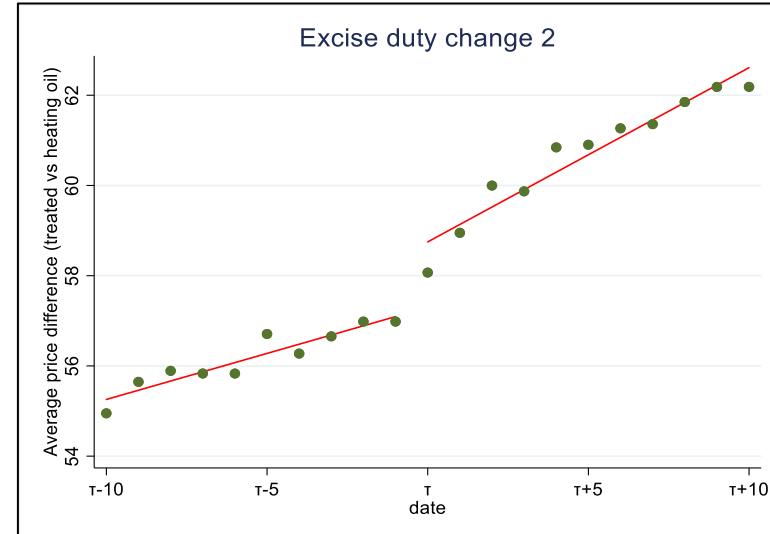$$P_{kist} = \rho Tax_{kt} + \lambda_t + \lambda_{ks} + \varepsilon_{kist}$$
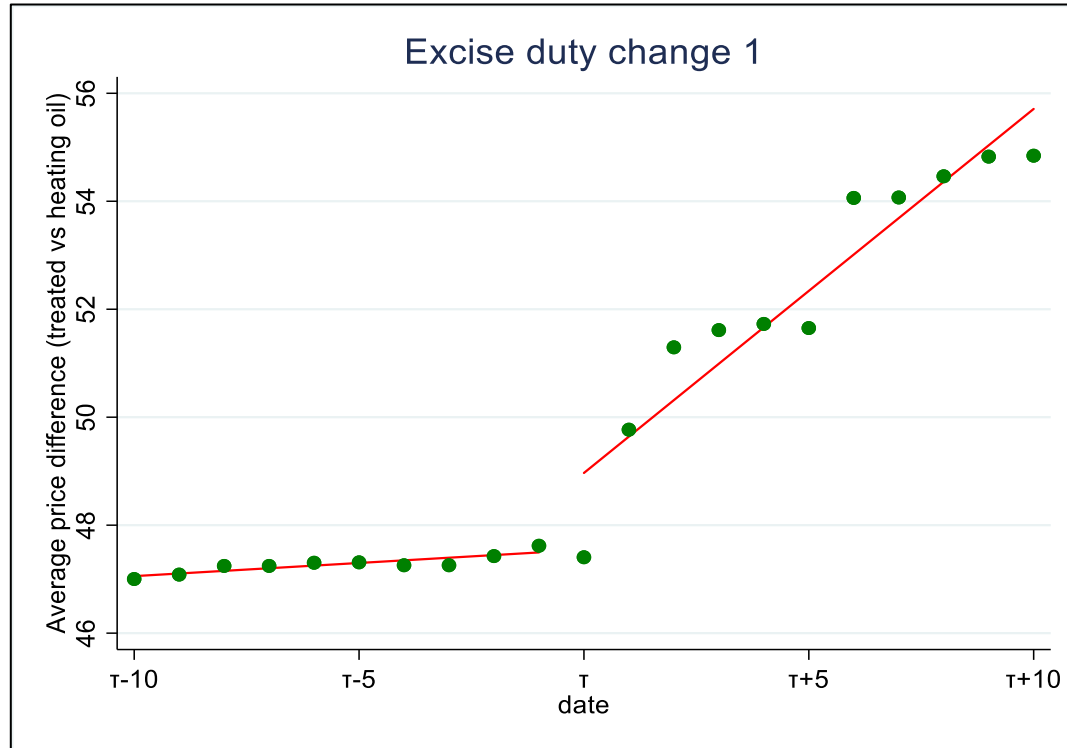
for product *k*, on island *i*, in gas station *s*, on day *t*.

- Time window: 10-day $\{\tau - 1, \tau + 10\}$

- Controls: product-station FE, day (doy) FE

- Standard errors clustered at the island level

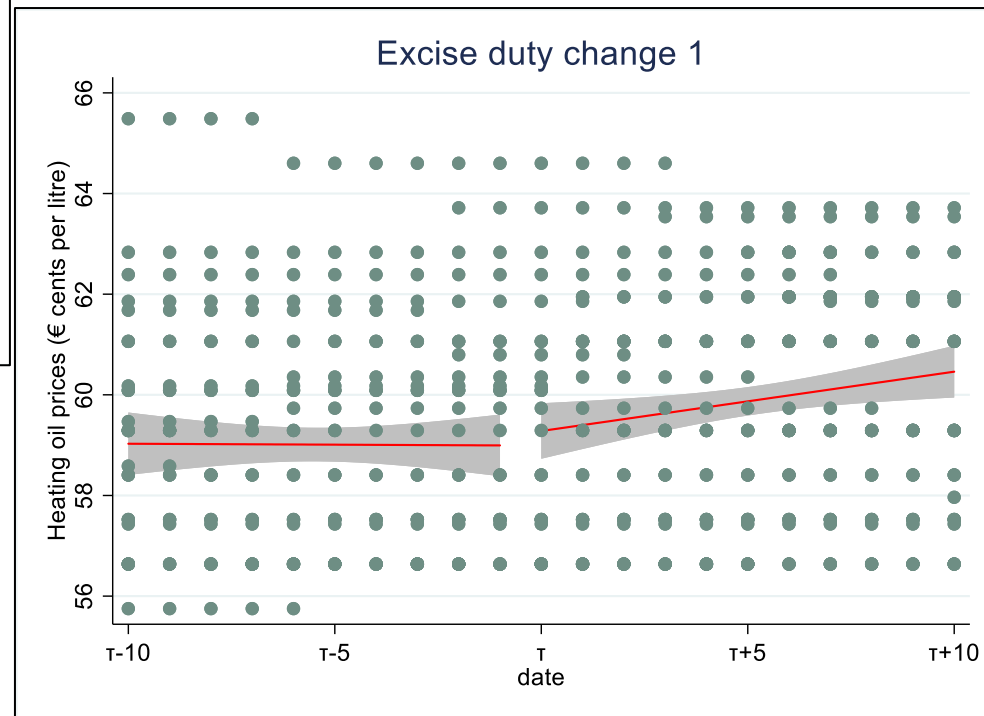- ❖ **Identification**: control group (heating oil) allows us to identify pass-through
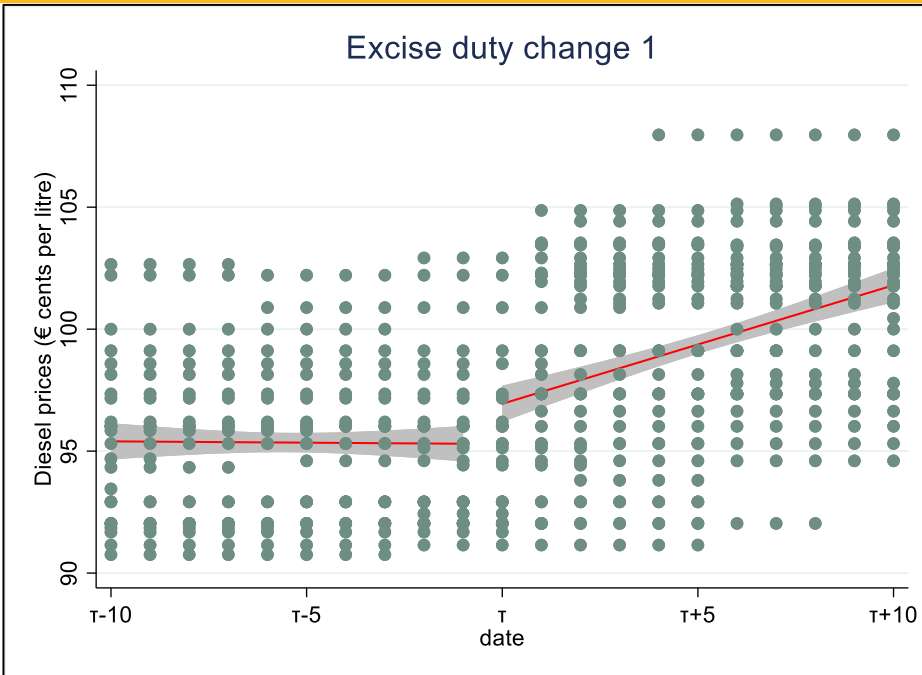
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Parallel Trends BEFORE any changes

DiD in pictures

Excise duty change 1

Excise duty change 2

Excise duty change 3
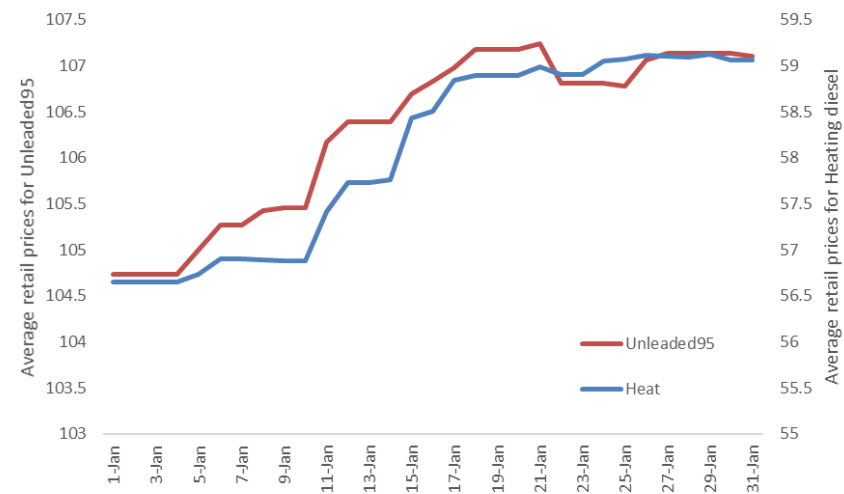
Treatment & Control (excise 1)

Result 1: almost complete overall pass-through

	3 days	7 days	10 days
excise change 1	49%	95%	96%
excise change 2	43%	69%	87%
excise change 3	77%	96%	97%
ALL	59%	88%	94%

Speed of adjustment

- Pass-through depends on **extensive** (how many stations adjusted their prices) and **intensive** (what was the size of the price change) margin.

- Long horizon → no difference, short horizon → BIG difference

- <u>Conditional on changing prices</u> pass-through 77% (63%-90%)
- No significant differences across products or excise incidents.

	(1)	(2)	(3)	(4)
Estimation method	FE	FE	FE	FE
Dependent variable	Price$_{ist}$	Price$_{ist}$	Price$_{ist}$	Price$_{ist}$
Sample	Excise 1	Excise 2	Excise 3	All excise episodes
Tax$_{it}$	0.690***	1.076***	0.661***	0.767***
	(0.087)	(0.111)	(0.097)	(0.069)
Observations	283	267	365	915
Within R^2	0.743	0.757	0.662	0.931
Clusters	37	41	55	57

Methodology

- Difference-in-Differences framework:

$$P_{kist} = \rho(n_i, Z_i)Tax_{kt} + \lambda_t + \lambda_{ks} + \varepsilon_{kist}$$

for product *k*, on island *i*, in gas station *s*, on day *t*.
Interaction of Tax with n_i: number of competitors

- Alternatively, non-parametrically $\rho(n_i) = \sum_j \rho_j I(n_i = j)$

- ❖ **Identification**: variation of competition across islands

- ❖ Robustness: control for island characteristics (Z_i) and use island **population** as **IV**

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Result 2: positive & non-linear relationship between competition and pass-through

	(1)	(4)
Estimation method	FE	FE
Dependent variable	$Price_{ist}$	$Price_{ist}$
Sample	All excise episodes	All excise episodes
Tax_{it}	0.449***	0.139
	(0.091)	(0.186)
$Tax_{it} \times$ Number of competitors$_s$	0.086***	0.289***
	(0.020)	(0.100)
$Tax_{it} \times$ Number of competitors$_s^2$		-0.025**
		(0.011)
Observations	915	915
Within R^2	0.937	0.939
Clusters	57	57

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Result 2: positive & non-linear relationship between competition and pass-through
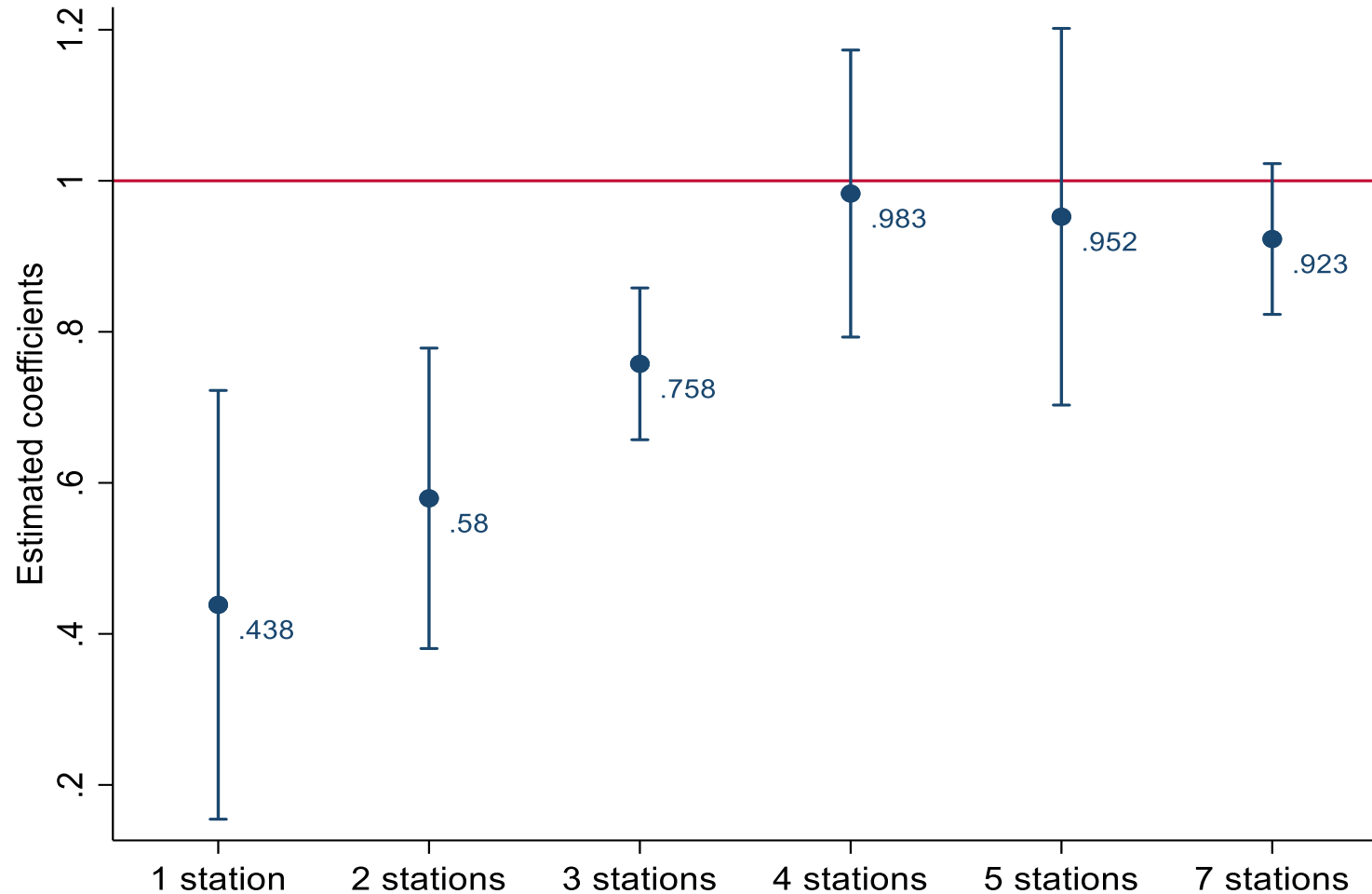
Result 2: implied intensity of competition
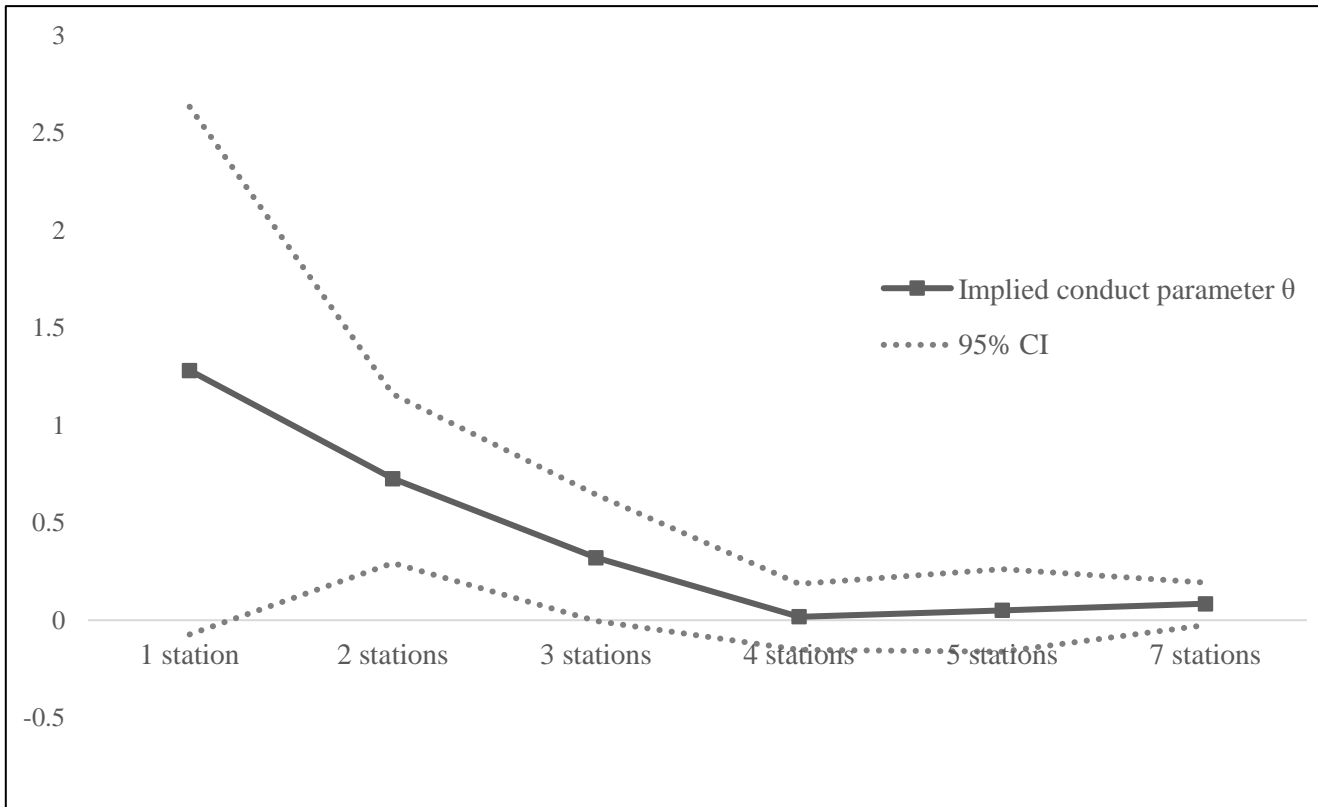
- ➢ If we assume that demand is linear, then behavioral parameter $\theta = \frac{1-\rho}{\rho}$ can be recovered from estimated pass-through.

- ➢ Degree of market power sharply decreases and gets very close to zero with ≥ 4 firms (similar to Bresnahan and Reiss, 1991).

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Robustness: controlling for island characteristics and IV

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	FE	FE	IV	FE	FE	IV
Dependent variable	$Price_{ist}$	$Price_{ist}$	$Price_{ist}$	$Price_{ist}$	$Price_{ist}$	$Price_{ist}$
Sample	All excise episodes	All excise episodes	All excise episodes	All excise episodes	All excise episodes	All excise episodes
Tax_{it}	0.449***	-0.833	0.464***	0.139	-0.601	-0.702
	(0.091)	(0.689)	(0.104)	(0.186)	(0.897)	(0.466)
$Tax_{it} \times$ Number of competitors$_s$	0.086***	0.083**	0.082***	0.289***	0.265	0.821***
	(0.020)	(0.031)	(0.020)	(0.100)	(0.172)	(0.294)
$Tax_{it} \times$ Number of competitors$_s^2$				-0.025**	-0.023	-0.090**
				(0.011)	(0.018)	(0.037)
		Additional controls include interactions with income, education, number of ports, and airports, distance from Piraeus and tourist arrivals.			Additional controls include interactions with income, education, number of ports, and airports, distance from Piraeus and tourist arrivals.	
Instruments						
First Stage Coef. Population			0.513***			1.149***
			(0.069)			(0.101)
First Stage Coef. Population^2						-0.057***
						(0.010)
First Stage F-test for Number of competitors			54.63***			108.01***
			[0.000]			[0.000]
First Stage Coef. Population						8.246***
						(1.131)
First Stage Coef. Population^2						-0.358***
						(0.100)
First Stage F-test for Number of competitors^2						42.01***
						[0.000]

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Pass-through and speed of adjustment

➢ How does the adjustment varies over time?

- **Conditional** pass-through: conditional on changing prices what was the size of the price change (intensive margin)

- **Average** pass-through: pool all stations together independent of whether they adjusted their prices or not (extensive margin)

- Long horizon → no difference,
  short horizon → BIG difference

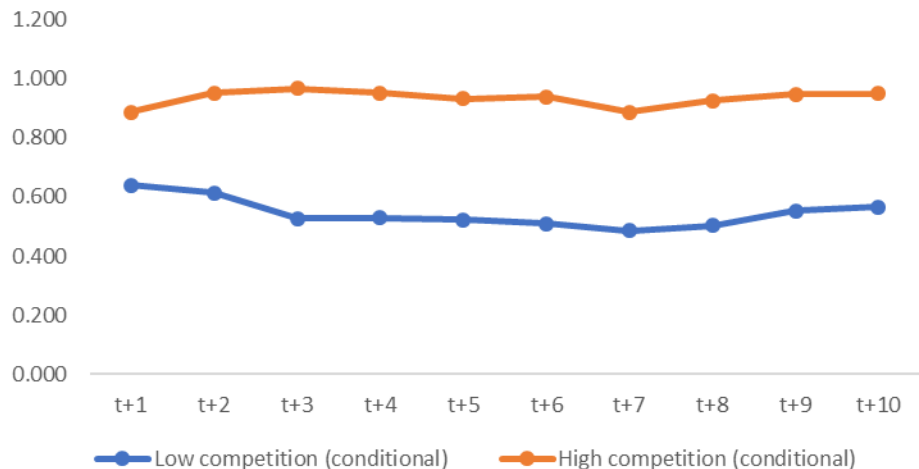➢ Does the speed of adjustment depend on competition?
  - Frequency of changes vs. magnitude of changes

Result 3: Pass-through and speed of adjustment
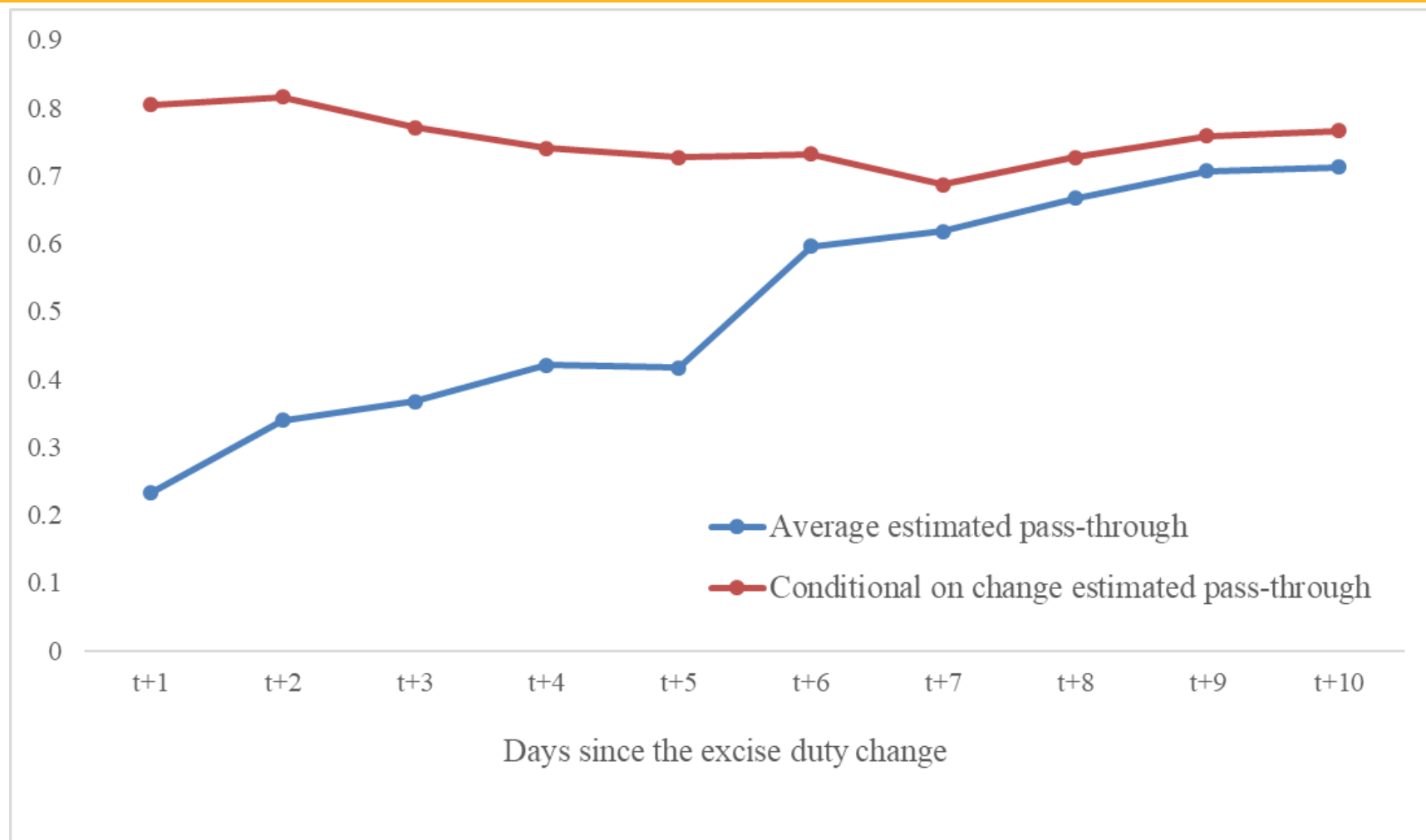
Result 3: Competition and speed of adjustment

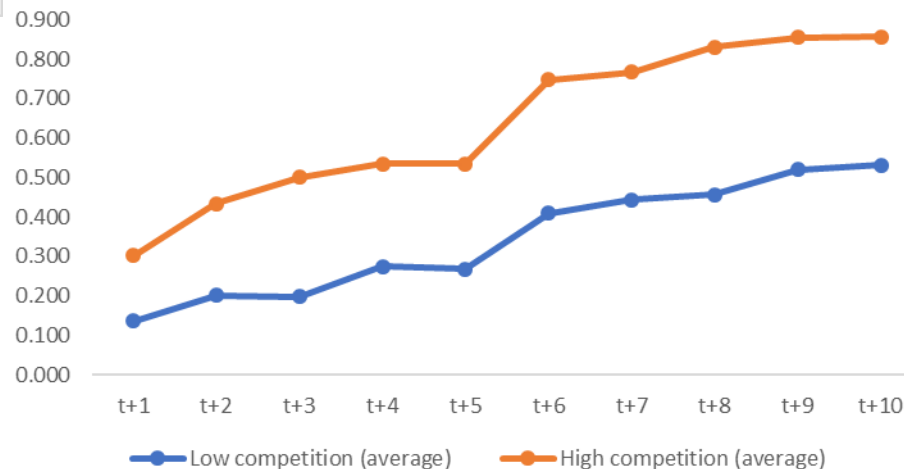The conditional pass-through is stable and significantly higher in islands with more competitors.

The average pass-through is significantly higher in islands with more competitors.
At t+1 about double
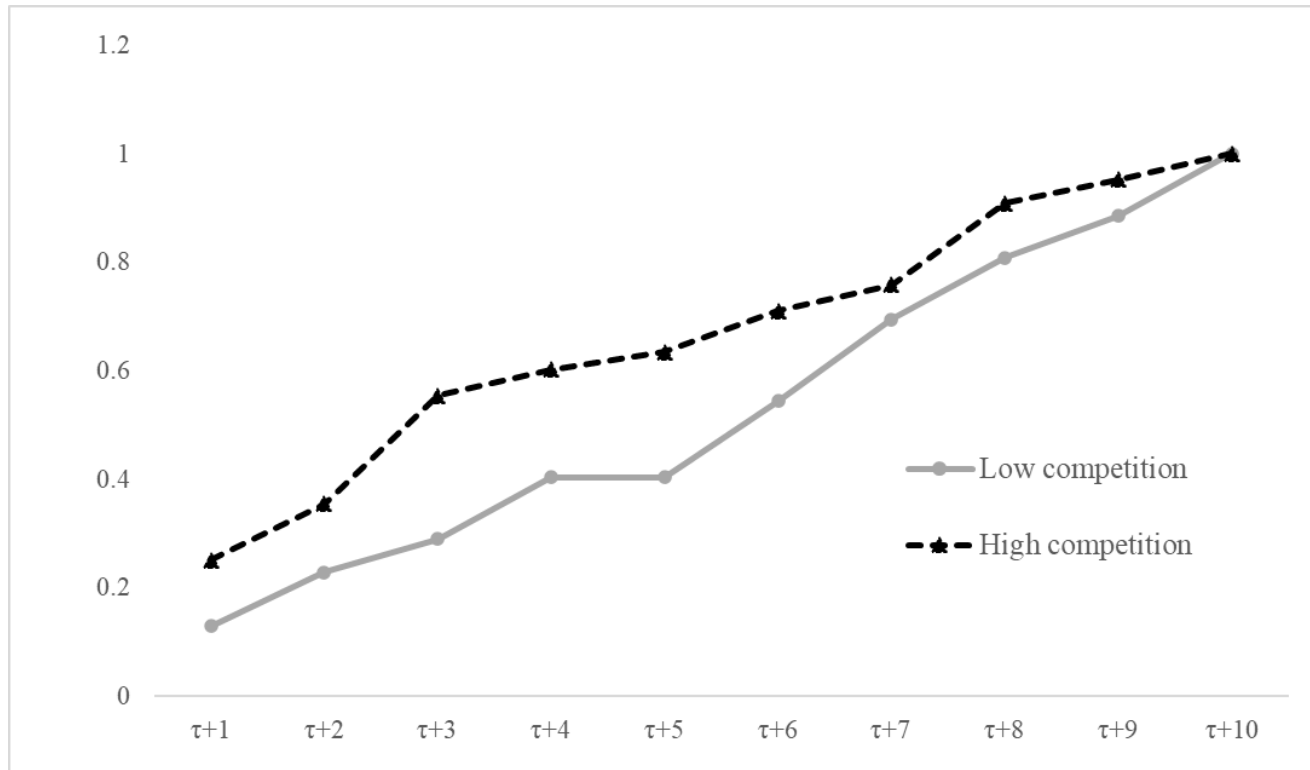At t+10 about 60% higher

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Competition and frequency of changes

More competitive markets adjust faster to cost shocks because price adjustments are larger
AND
more frequent!
(Gopinath and Itskhoki, 2010)

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Geographic market definition

- What is the right geographical market definition?

- With no clear definition of market boundaries or detailed traffic data, researchers and policy makers define markets based on ***arbitrary distances*** across gas stations:
  - ✓ 3-kilometer radius
  - ✓ 3-kilometer (or 5-kilometer) distance (road structure)
  - ✓ 5-minute (or 10-minute) drive time (road structure + geography)

- We apply these arbitrary geographical market definitions and compare them with "our" island market definition

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Result 4: Pass-through overestimation
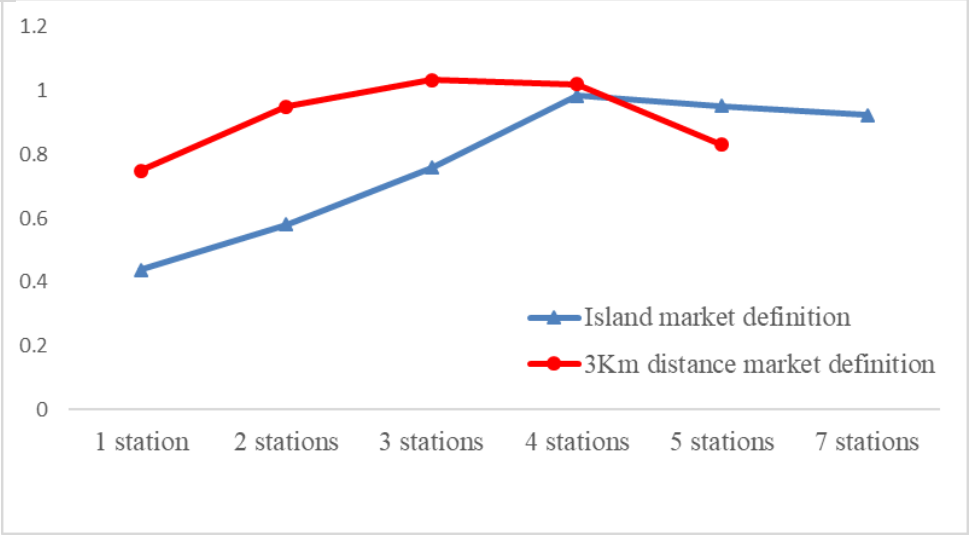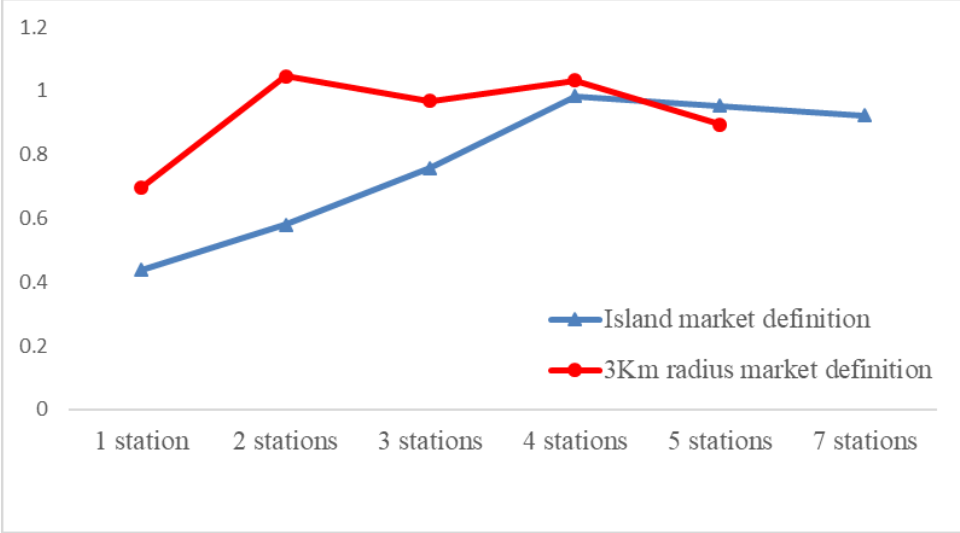
Result 4: Pass-through overestimation
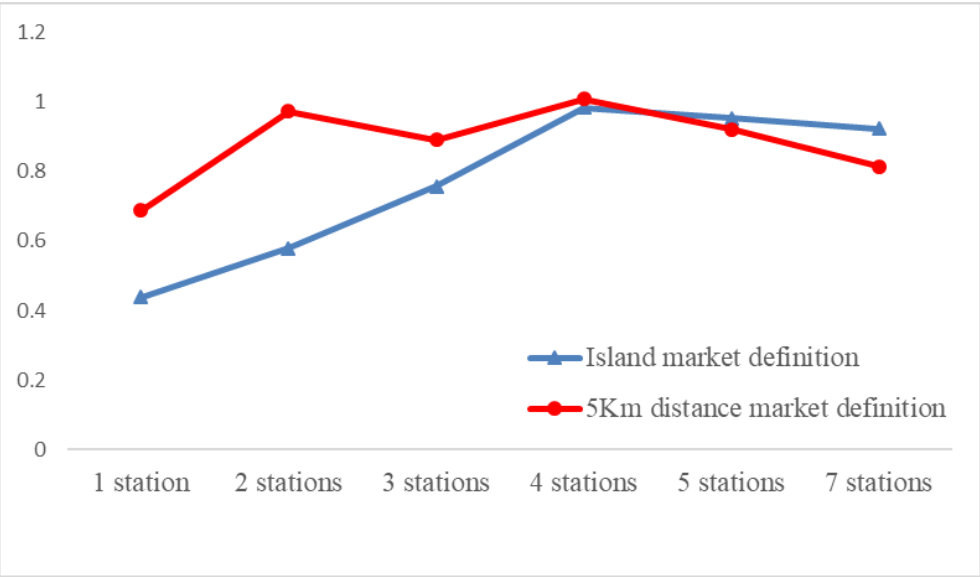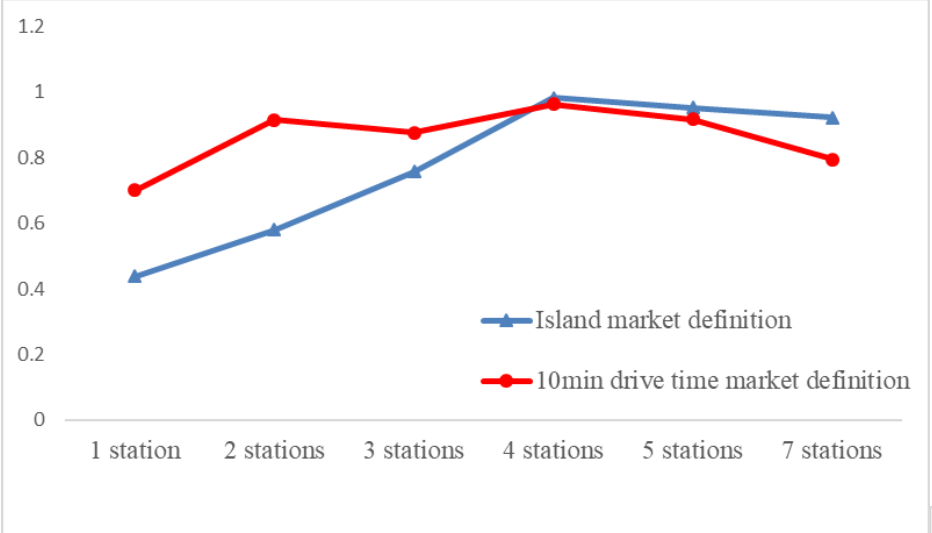
Conclusions

✓ First systematic examination of how pass-through varies with competition in isolated markets with captive consumers.

✓ Unique market set-up: exogenous market structure, unexpected and large changes in excise duties, good exogenous control group.

✓ Main results:

1) **pass-through increases with competition in a non-linear fashion**, going from 44% in a monopoly to 100% in markets for ≥ 4 competitors.

2) **Speed of adjustment is faster in more competitive markets,** both due to the size AND the frequency of changes.

3) **Conventional market definitions** based on distance between sellers **overestimate the pass-though** for markets with up to 3 competitors.

PASS-THROUGH AND COMPETITION

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