COMPETITION AND PASS-THROUGH: EVIDENCE FROM THE GREEK ISLANDS

Christos GENAKOS
Cambridge Judge Business School, AUEB, CEP & CEPR

Mario PAGLIERO
Turin, Carlo Alberto & CEPR
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
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?
Discussion based on Weyl and Fabinger (2013):

- Symmetric firms & perfect competition: $\rho = \frac{1}{1 + \frac{\varepsilon_D}{\varepsilon_S}}$
- Monopoly: $\rho = \frac{1}{1 + \frac{\varepsilon_D - 1}{\varepsilon_S} + \frac{1}{\varepsilon_{ms}}}$
- Symmetric imperfect competition: $\rho = \frac{1}{1 + \frac{\theta}{\varepsilon_\theta} + \frac{\varepsilon_D - \theta}{\varepsilon_S} + \frac{\theta}{\varepsilon_{ms}}}$
- Asymmetric: same ideas, more complicated formula

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

If $mc$ constant then $\rho = \frac{1}{1 + \theta}$ as competition ↑, pass-through ↑

If $\theta$ constant

Demand linear
Industry background

- Petroleum industry: refineries → wholesalers → retailers
- Taxation of petroleum products:
  \[ P_{\text{retail}} = (P_{\text{refinery}} + \text{taxes&fees} + \text{margins})(1 + \text{VAT}) \]
- Financial/debt crisis: significant increase in excise duties

<table>
<thead>
<tr>
<th>Date</th>
<th>Δunleaded</th>
<th>Δdiesel</th>
<th>Δsuper</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/2/2010</td>
<td>29%</td>
<td>17%</td>
<td>29%</td>
</tr>
<tr>
<td>4/3/2010</td>
<td>15%</td>
<td>9%</td>
<td>15%</td>
</tr>
<tr>
<td>3/5/2010</td>
<td>10%</td>
<td>8%</td>
<td>10%</td>
</tr>
</tbody>
</table>

- No change in excise duty for heating diesel (chemically identical to Diesel, just colored): control group
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
Competition and Market Size

The graphs illustrate the relationship between the number of gas stations and two different metrics: island population and island size (in km²). The scatter plots show a positive correlation, indicating that areas with more gas stations tend to have larger populations and larger island sizes. The lines represent the trend and the shaded areas indicate the confidence intervals.
Competition and Prices
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 station level**

- **Identification:** control group (heating diesel) allows us to identify pass-through
Parallel Trends BEFORE any changes
DiD in pictures

Excise duty change 1

Excise duty change 2

Excise duty change 3
Treatment & Control (excise 1)
Treatment & Control (excise 2)
Treatment & Control (excise 3)
Result 1: almost complete overall pass-through

<table>
<thead>
<tr>
<th></th>
<th>3 days</th>
<th>7 days</th>
<th>10 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>excise change 1</td>
<td>49%</td>
<td>95%</td>
<td>96%</td>
</tr>
<tr>
<td>excise change 2</td>
<td>43%</td>
<td>69%</td>
<td>87%</td>
</tr>
<tr>
<td>excise change 3</td>
<td>77%</td>
<td>96%</td>
<td>97%</td>
</tr>
<tr>
<td>ALL</td>
<td>59%</td>
<td>88%</td>
<td>94%</td>
</tr>
</tbody>
</table>

**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

- Conditional on changing prices pass-through 77% (63%-90%)

- No significant differences across excise incidents.
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
Result 2: positive & non-linear relationship between competition and pass-through

<table>
<thead>
<tr>
<th>Estimation method</th>
<th>(1)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable</td>
<td>FE</td>
<td>FE</td>
</tr>
<tr>
<td></td>
<td>$\text{Price}_{\text{ist}}$</td>
<td>$\text{Price}_{\text{ist}}$</td>
</tr>
<tr>
<td>Sample</td>
<td>All excise episodes</td>
<td>All excise episodes</td>
</tr>
<tr>
<td>$\text{Tax}_{it}$</td>
<td>0.449***</td>
<td>0.139</td>
</tr>
<tr>
<td></td>
<td>(0.091)</td>
<td>(0.186)</td>
</tr>
<tr>
<td>$\text{Tax}_{it} \times \text{Number of competitors}_s$</td>
<td>0.086***</td>
<td>0.289***</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.100)</td>
</tr>
<tr>
<td>$\text{Tax}_{it} \times \text{Number of competitors}_s^2$</td>
<td>-0.025**</td>
<td>-0.025**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.011)</td>
</tr>
<tr>
<td>Observations</td>
<td>915</td>
<td>915</td>
</tr>
<tr>
<td>Within $R^2$</td>
<td>0.937</td>
<td>0.939</td>
</tr>
<tr>
<td>Clusters</td>
<td>57</td>
<td>57</td>
</tr>
</tbody>
</table>
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 $\geq 4$ firms (similar to Bresnahan and Reiss, 1991).
## Robustness: controlling for island characteristics and IV

<table>
<thead>
<tr>
<th>Estimation method</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample</td>
<td>FE</td>
<td>FE</td>
<td>IV</td>
<td>FE</td>
<td>FE</td>
<td>IV</td>
</tr>
<tr>
<td>Dependent variable</td>
<td>Price_{ist}</td>
<td>Price_{ist}</td>
<td>Price_{ist}</td>
<td>Price_{ist}</td>
<td>Price_{ist}</td>
<td>Price_{ist}</td>
</tr>
</tbody>
</table>

| Tax_{n}          | 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_{n} \times \text{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_{n} \times \text{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.

<table>
<thead>
<tr>
<th>Instruments</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>First Stage Coef. Population</td>
<td>0.513***</td>
<td></td>
<td></td>
<td></td>
<td>1.149***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.069)</td>
<td></td>
<td></td>
<td></td>
<td>(0.101)</td>
<td></td>
</tr>
<tr>
<td>First Stage Coef. Population^2</td>
<td>-0.057***</td>
<td></td>
<td></td>
<td></td>
<td>-0.358***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td></td>
<td></td>
<td></td>
<td>(0.100)</td>
<td></td>
</tr>
<tr>
<td>First Stage F-test for Number of competitors</td>
<td>54.63***</td>
<td></td>
<td></td>
<td></td>
<td>108.01***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.000]</td>
<td></td>
<td></td>
<td></td>
<td>[0.000]</td>
<td></td>
</tr>
<tr>
<td>First Stage Coef. Population</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.246***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1.131)</td>
<td></td>
</tr>
<tr>
<td>First Stage Coef. Population^2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.358***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.100)</td>
<td></td>
</tr>
<tr>
<td>First Stage F-test for Number of competitors^2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>42.01***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[0.000]</td>
<td></td>
</tr>
</tbody>
</table>
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
More competitive markets adjust faster to cost shocks because price adjustments are larger AND more frequent! (Gopinath and Itskhoki, 2010)
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
Result 4: Pass-through overestimation

Competition and Pass-Through | Genakos & Pagliero

[Graph 1: Comparison of Island market definition and 3Km radius market definition for different station counts.]

[Graph 2: Comparison of Island market definition and 3Km distance market definition for different station counts.]
Result 4: Pass-through overestimation
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-through for markets with up to 3 competitors.
COMPETITION AND PASS-THROUGH: EVIDENCE FROM GREEK ISLANDS

Christos GENAKOS
Cambridge Judge Business School, AUEB, CEP & CEPR

Mario PAGLIERO
Turin, Carlo Alberto & CEPR