Competition and VAT Pass-Through
Evidence from the Greek Islands

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1 Introduction

2 Setting and Data

3 Methodology

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Pass-through and Competition

**Tax pass-through**: The extent of the change in the price of a firm’s product or service, due to a change in a tax rate.

**Theoretical Evidence**: Competition is a key determinant of pass-through, but its effect is ambiguous.

The sign and the magnitude depend on factors such as:

- Curvature of the demand function
- Supply and demand elasticities
- Elasticity of the inverse cost function
Empirics: Well-established research exploiting the variability in tax rates to infer the magnitude of the pass-through.

Typical approaches on the cost pass-through can be divided into two categories:

- Same product in different countries (Benedek et al, 2020)
- Different products in the same country (Benzarti and Carloni, 2019)

However, very little evidence how pass-through varies with competition (Genakos and Pagliero, 2022).

Popular way to capture the competitiveness of a market:

- Number of competitors located within a given geographical area around each firm (Stolper, 2021)
1 Introduction

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What happened?

110 Bill loan
Commitment for austerity measures and tax increases

- 10/5/2010
- 1/10/2015
- 1/6/2016
- 1/1/2018
Industry background and data

- VAT increase (17% to 24%) on islands located in the borders on January 1, 2018.
- Daily station-level retail prices for Diesel and Unleaded95 gasoline products across Greek islands for 2017-2018.
- Socio-economic (population, tourists, ports, number of gas stations etc) and geographic (size, distance between islands) characteristics of each island.
Competition and Market Size

- Island size (km²) vs. number of gas stations
- Island population vs. number of gas stations
Competition and Prices

Two scatter plots are shown, each depicting the relationship between the number of gas stations and the average price of unleaded and diesel fuels, respectively. The plots suggest a negative correlation, indicating that as the number of gas stations increases, the average prices tend to decrease.
Our goal:

- Impact of competition on VAT Pass-through
- How the speed of price adjustment varies with competition
- Heterogeneity across products (Unleaded95 vs Diesel)
Identification Strategy:

- Difference in Differences methodology
  - Treatment group: Islands which were affected by the VAT change.
  - Control group: Islands which weren’t affected by the policy change and have the same number of competitors as the treated islands.

Ideal Experiment:

- VAT increase only in islands which are located close to the borders (Random treatment!).
- Exogenous variation in market size (Islands of different size).
- No substitution effects across islands.
- Gasoline products: Almost zero income effects.
Greek islands

<table>
<thead>
<tr>
<th></th>
<th>(1) Treatment</th>
<th>(2) Control</th>
<th>P-Value</th>
</tr>
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<tbody>
<tr>
<td>Competitors</td>
<td>5.125</td>
<td>6</td>
<td>0.756</td>
</tr>
<tr>
<td>Population</td>
<td>6342.375</td>
<td>8791.263</td>
<td>0.590</td>
</tr>
<tr>
<td>Size (Km²)</td>
<td>154.494</td>
<td>122.041</td>
<td>0.597</td>
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<tr>
<td>Ports</td>
<td>1.5</td>
<td>1.737</td>
<td>0.667</td>
</tr>
<tr>
<td>Income</td>
<td>16742.2</td>
<td>17248.25</td>
<td>0.554</td>
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</table>

Treatment-Control islands: No significant difference in mean characteristics
<table>
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<th>Section</th>
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**Competition and VAT Pass-Through**
Identification Strategy

Difference in Difference Methodology:

$$\ln(P_{ijtg}) = \beta_0 + \beta_1 \text{VAT}_{it} + \lambda_t + \mu_{jg} + e_{ijtg}$$

- For product j on island i, in gas station g, on day t.
- \(\text{VAT}_{it}\): VAT rates of each island at different points in time.
- Standard errors are clustered at the island level.
- Time window: 17-day \([\tau - 1, \tau + 15]\).
Parallel trends assumption tests

\[
\ln(P_{ijtg}) = \gamma_0 + \gamma_1 \text{Trend}_t + \gamma_T \text{Trend}_t \times \text{Treat} + \lambda_t + \mu_{jg} + e_{ijtg}
\]

\[
\ln(P_{ijtg}) = \gamma_0 + \gamma_1 t \times \text{Trend}_t + \gamma_T t \times \text{Trend}_t \times \text{Treat} + \lambda_t + \mu_{jg} + e_{ijtg}
\]

- Trend: time binary variables
- Treat: island binary variable that equals to one for the treated islands.
- \([\tau - 15, \tau - 1]\)
- We cannot reject the null hypothesis that the \(\gamma_T\) is equal to zero.
DiD in pictures

Unleaded 95

Diesel

Average price difference (treatment vs control)

17/12/17  01/01/18  16/01/18

Date

17/12/17  01/01/18  16/01/18

Date

-50  0  50  100

-20  0  20  40  60  80
Pass-through and Competition

**Graphs:**
- **OLS**
- **Matching**

The graphs compare pass-through rates across different numbers of competitors, showing a decrease as the number of competitors increases.
How does the adjustment vary over time?

- **Average** pass-through: across all stations independently of whether have changed their prices or not
- **Conditional** pass-through: conditional on changing their prices
Pass-through and speed of adjustment
Competition and Speed of Adjustment

Does the speed of price adjustment depends on competition?

- **Low competition**: monopolies and duopolies
- **High competition**: more than seven competitors
The speed of price adjustment is increasing in competition.

Probit model: The probability of a price change is not systematically related to the island size, population and distance from the mainland.
The pass-through is higher in more competitive markets.
The speed of price adjustment is faster in more competitive markets.
Average - conditional pass-through convergence on the 2nd and 10th day in high and low competitive markets respectively.
**Heterogeneity across products**

**Introduction**

**Setting and Data**

**Methodology**

**Results**

**Conclusions**

**Appendix**

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### Table: Average and conditional pass-through

| VARIABLES                      | Average log(Price\_log) | Conditional log(Price\_log) |  
|--------------------------------|--------------------------|----------------------------|---
| VAT                            | 0.697*** (0.0933)        | 0.765*** (0.0535)           |   
| VAT*Unleaded95                 | 0.641*** (0.096)         | 0.715*** (0.051)            |   
| VAT*Diesel                     | 0.757*** (0.090)         | 0.817*** (0.056)            |   

**Observations**: 484

**R-squared**: 0.848

**Station*Type FE**: YES

**Date FE**: YES

**F-test for equality of coefficients (P-value)**: 31.10 (0.000)

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### Table: Pass-through (low vs high competition by product)

| VARIABLES                           | Average log(Price\_log) | Conditional log(Price\_log) |  
|-------------------------------------|--------------------------|----------------------------|---
| VAT\_Low competition*Unleaded95     | 0.514*** (0.111)         | 0.516*** (0.111)           |   
| VAT\_Low competition*Diesel         | 0.659*** (0.113)         | 0.662*** (0.113)           |   
| VAT\_High competition*Unleaded95    | 0.662*** (0.104)         | 0.753*** (0.033)           |   
| VAT\_High competition*Diesel        | 0.775*** (0.097)         | 0.848*** (0.046)           |   

**Observations**: 484

**R-squared**: 0.855

**Station*Type FE**: YES

**Date FE**: YES

**F-tests for equality of coefficients**

- Low competition(U95) = Low competition(Diesel) 10.13 (0.004)
- High competition(U95) = High competition(Diesel) 24.16 (0.000)

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**Diesel pass-through is significantly greater.**

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Conclusions

- Ideal experiment: exogenous market structure, random treatment group, ideal product.
- Three main results:
  - Pass-through increases with competition going from 50% in monopoly to 80% in highly competitive markets.
  - Speed of price adjustment is faster in more competitive markets.
  - Significant heterogeneity between the pass-through rates of different gasoline products.
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Announcement

Announcement: 19/12/2017
First day of the regulation: 1/1/2018

Is there an impact due to the early announcement?
Identification Strategy

Difference in Difference Methodology:

$$\ln(P_{ijtg}) = \beta_0 + \beta_1 \text{VAT}_{it} + X_t + X_{jg} + e_{ijtg}$$

- for product $j$ on island $i$, in gas station $g$, on day $t$.
- $\text{VAT}_{it}$: VAT rates of each island at different points in time.
- standard errors are clustered at the island level.
- Time window: 27-day $[\tau - 14, \tau + 15]$
Pass-through and speed of adjustment

![Graph showing pass-through and the speed of adjustment over time.](image-url)
Price adjustment

Speed of adjustment

Cumulative percentage of stations that changed their prices

Day

T-10 T-5 T T+5 T+10 T+15

High Competition

Low Competition

Competition and VAT Pass-Through
Competition and Speed of Adjustment

Speed of adjustment and competition

Days since the VAT change

- Low competition (average)
- Low competition (conditional)
- High competition (average)
- High competition (conditional)

Pass-through
<table>
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<tr>
<th>Monopolies</th>
<th>Duopolies</th>
<th>8+ competitor markets</th>
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<tbody>
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<td>Treatment</td>
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