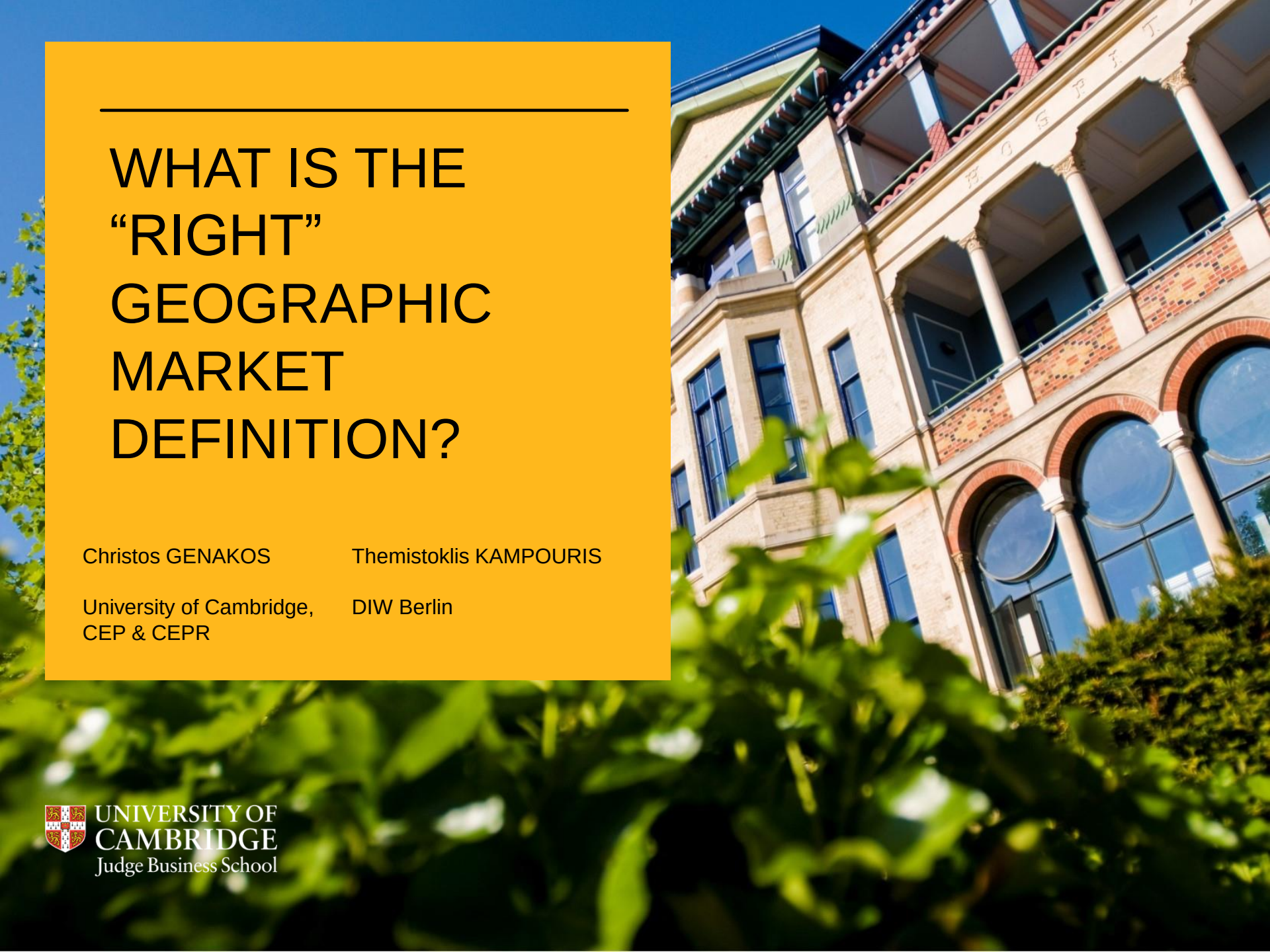
WHAT IS THE "RIGHT" GEOGRAPHIC MARKET DEFINITION?

Christos GENAKOS

University of Cambridge,
CEP & CEPR

Themistoklis KAMPOURIS

DIW Berlin



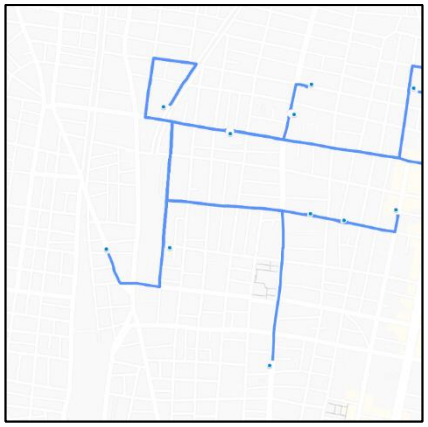
UNIVERSITY OF CAMBRIDGE
Judge Business School

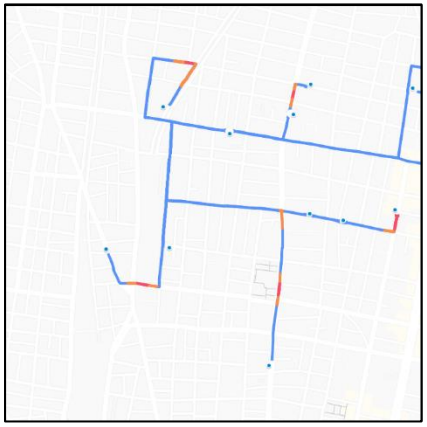
Geographic market definition

- Spatial competition and differentiation hugely important in markets where suppliers directly interact with end consumers (ex. supermarkets, pharmacies, gas stations etc).
- Central issue: how geography limits willingness and ability of consumers to substitute from one supplier to another.
- Geographic boundaries depend on consumers' preferences, transportation costs, search costs and information.
- Substitution patterns and definition of relevant market essential for antitrust and competition authorities worldwide.
- Typically, number of competitors "located" nearby (arbitrary and problematic) with no attention to *market structure endogeneity.*

Geographic market definition

- Isodistance measures: draw circles around stations
- Isochrone measures: drive distance or drive time





- Price correlation test
- Incorporate consumers' mobility: single address models (Davis, 2006; Thomasden, 2005) or multi-address models (Houde, 2012; Pennerstorfer et al., 2020) recognising that consumers do not always "start" from home and commuting/traffic flows matter.

This paper

And now, for something different…

- Use a natural experiment of a common cost shock to measure pass-through:
  - significant and unexpected changes in excise duty changes in gasoline products (Unleaded95, Unleaded100, Diesel, Super)
  - good control for local market conditions (Heating diesel)

- Use a good benchmark: pass-through & competition from Greek islands!
  - ✓ Greek islands: clearly defined markets with isolated customers
  - ✓ Markets of different sizes give us exogenous variation in market structure
  - ✓ Use Genakos and Pagliero (2022) measure of how pass-through varies with competition: clean benchmark

This paper

Idea:

1. Define local markets in Athens metropolitan area
   - X-km radius (geography)
   - X-km driving distance (road structure)
   - X-min drive time (road structure + geography)
2. Measure how pass-through varies with competition
3. Compare & test pattern to pass-through estimates from the islands

Theory

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

Data

- **Daily** station-level **retail prices** for **all** available gasoline products in the **Athens** metropolitan area in 2010 from the Ministry of Development & Competitiveness (www.fuelprices.gr)

- **Geo-located** each gas station (ministry + google) and calculated “local” markets using **isodistance** (X-km radius or driving distance) and **isochrone** (X-min driving distance) **maps**

- Key question: what is the “right” definition so that we match pass-through for monopolists, duopolists, etc from the islands?

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

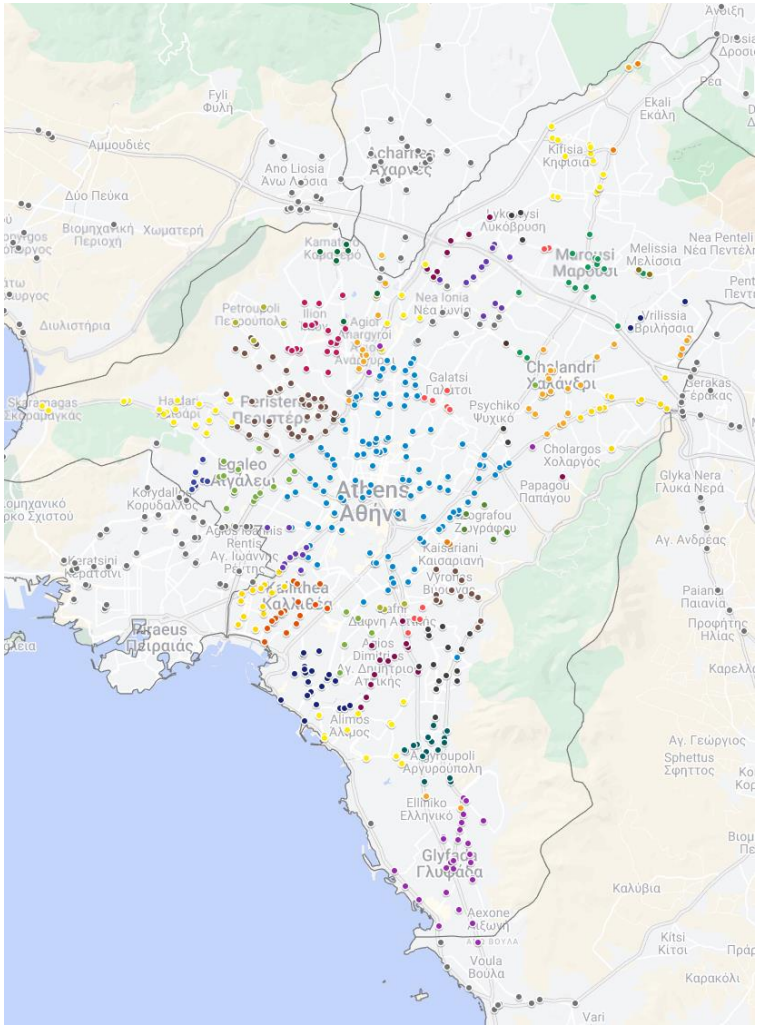
TABLE 1 - EXCISE DUTY TAX CHANGES (Δ%)

Type of energy product	(1) Unleaded 95	(2) Unleaded 100	(3) Diesel	(4) Super (leaded)	(5) Heating diesel
10-Feb-10	(29%)	(29%)	(17%)	(29%)	(0%)
04-Mar-10	(15%)	(15%)	(9%)	(15%)	(0%)
03-May-10	(10%)	(10%)	(8%)	(10%)	(0%)

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

Athens market

- Athens: capital & largest city
- We use it as an example of an urban area where the geographic market definition problem is more severe!
- How do you divide local markets?



Geographic market definition

TABLE 3.1: MARKET DEFINITION AND COMPETITION BASED ON RADIUS

Radius	0.1km	0.5km	1.0km	1.5km	2.0km
1 competitor	312	46	3	0	0
2 competitors	69	92	9	4	3
3 competitors	2	95	14	0	0
4 competitors		58	13	1	0
5 competitors		39	17	8	0
6 competitors		31	28	2	0
7+ competitors		22	299	368	380
Mean	0	2	8	18	30
Median	0	2	8	17	29
25-th percentile	0	1	6	12	21
75-th percentile	0	3	11	23	39

Geographic market definition

TABLE 3.2: MARKET DEFINITION AND COMPETITION BASED ON DRIVING DISTANCE

Driving distance	1km	1.5km	2km
1 competitor	39	12	2
2 competitors	72	12	3
3 competitors	54	18	6
4 competitors	79	27	7
5 competitors	54	22	15
6 competitors	40	39	7
7+ competitors	45	253	343
Mean	3	7	13
Median	3	7	13
25-th percentile	1	5	9
75-th percentile	4	10	17

Geographic market definition

TABLE 3.3: MARKET DEFINITION AND COMPETITION BASED ON DRIVING TIME

Driving time	1m	2m	3m
1 competitor	269	130	46
2 competitors	91	120	58
3 competitors	20	68	60
4 competitors	3	38	74
5 competitors		19	46
6 competitors		5	50
7+ competitors		3	49
Mean	0	1	3
Median	0	1	3
25-th percentile	0	0	1
75-th percentile	1	2	5

Methodology

- Difference-in-Differences framework:

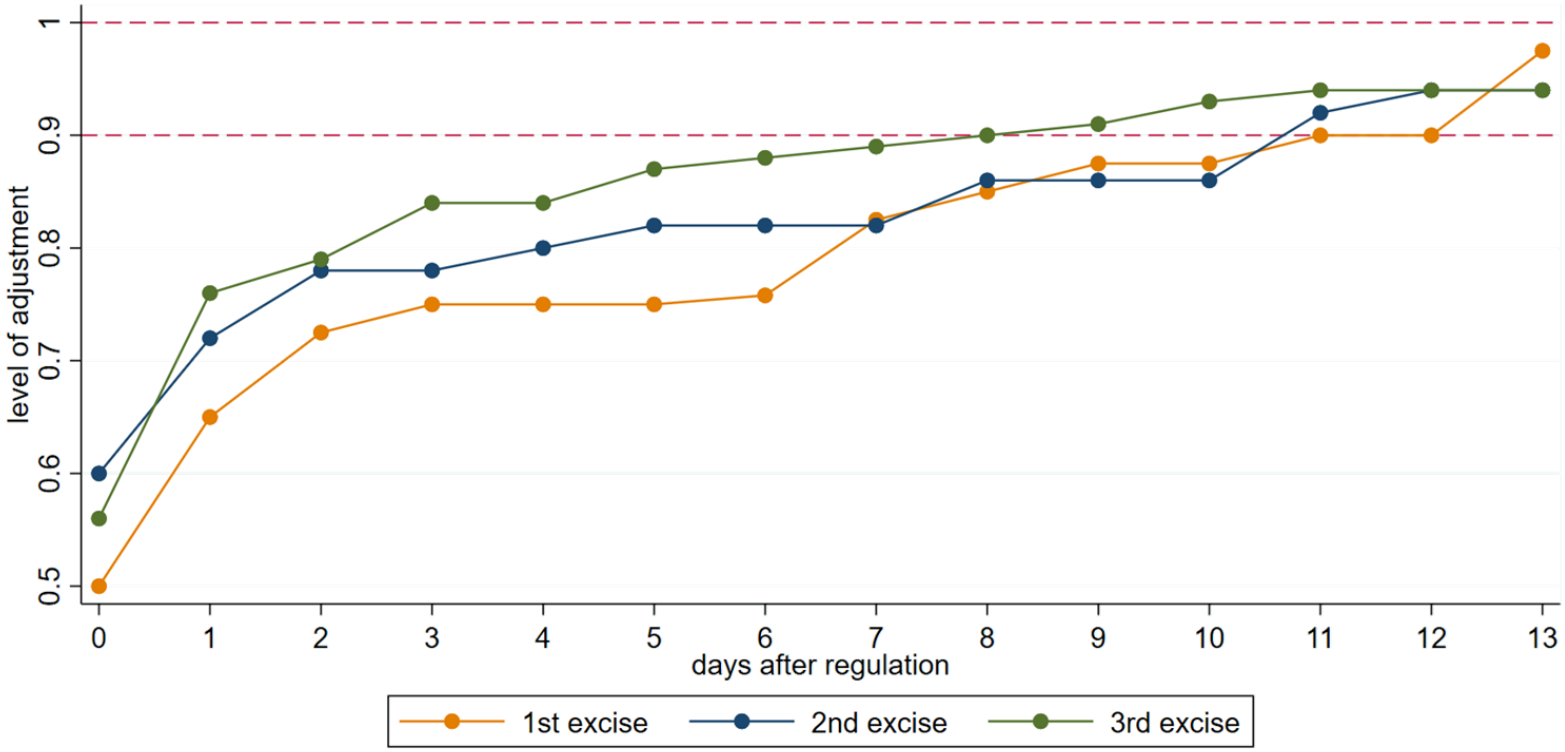
$$P_{jst} = \rho Tax_{jt} + \lambda_t + \lambda_{js} + \varepsilon_{jst}$$

for product *j* (diesel, Un95, Un100, super), station *s*, day *t.*

- Time window: 14-day $\{\tau - 1, \tau + 13\}$
- Controls: product-station FE, day FE
- Standard errors clustered at the gas-station level

❖ **Identification**: control group (heating diesel) allows us to identify pass-through

Cumulative adjustment percentage

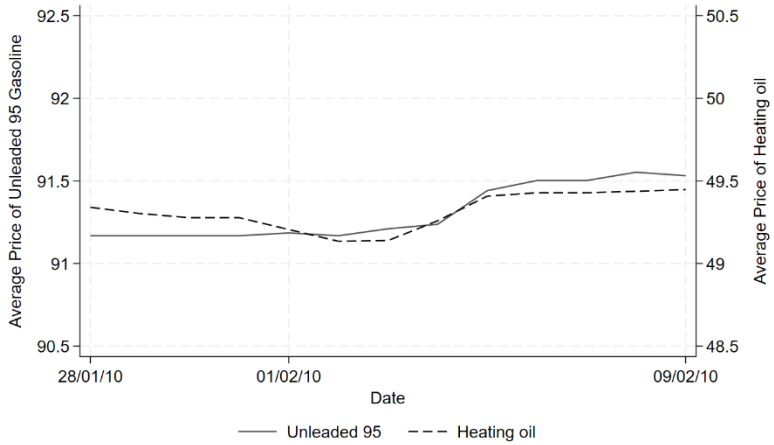


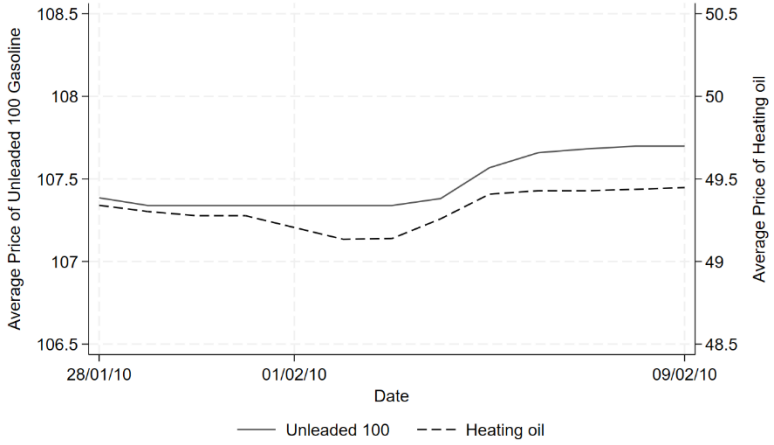
Parallel Trends BEFORE any changes

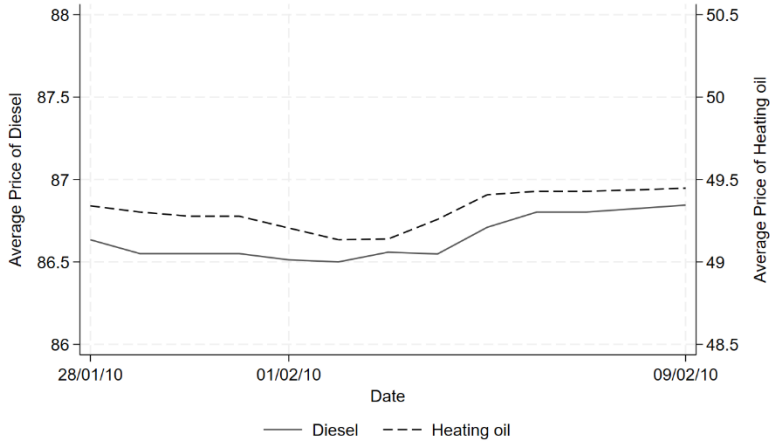
TABLE A1 - PARALLEL TREND TESTS

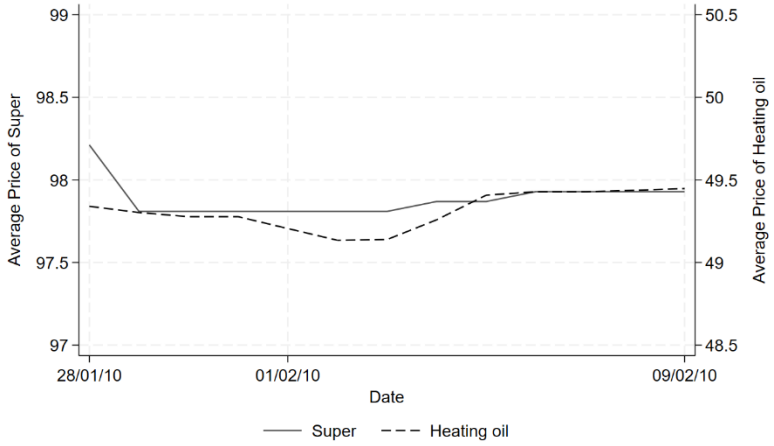
	(1) $Price_{jgt}$ 1st Excise	(2) $Price_{jgt}$ 2nd Excise	(3) $Price_{jgt}$ 3rd Excise
$Trend_t$	0.342**	1.676***	0.577**
	(0.138)	(0.232)	(0.248)
$Trend_t \times Treat$	0.089	0.131	0.156
	(0.125)	(0.316)	(0.272)
Window before the event	[τ-10, τ-1]	[τ-10, τ-1]	[τ-10, τ-1]
Adjusted R^2	0.977	0.981	0.984
Observations	1,840	2,248	3,603
Product type FE	yes	yes	yes
Station FE	yes	yes	yes

Parallel Trends BEFORE any changes









Parallel Trends BEFORE any changes

TABLE A2 - PARALLEL TREND TESTS

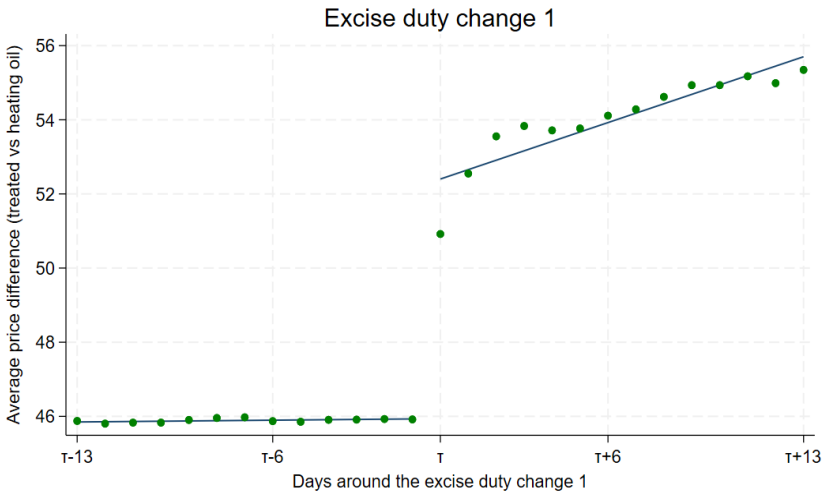
	(1) $Price_{jgt}$ 1st Excise	(2) $Price_{jgt}$ 1st Excise	(3) $Price_{jgt}$ 2nd Excise	(4) $Price_{jgt}$ 2nd Excise	(5) $Price_{jgt}$ 3rd Excise	(6) $Price_{jgt}$ 3rd Excise
$Trend_t$	0.342**	0.342**	1.676***	1.676***	0.577**	0.576**
	(0.138)	(0.138)	(0.232)	(0.232)	(0.248)	(0.248)
$Trend_t \times Treat$	0.089		0.131		0.156	
	(0.125)		(0.316)		(0.272)	
$Trend_t \times Unleaded\ 95$		0.179**		0.364		0.287
		(0.087)		(0.342)		(0.317)
$Trend_t \times Unleaded\ 100$		0.180		0.207		-0.020
		(0.128)		(0.448)		(0.407)
$Trend_t \times Diesel$		0.096		-0.201		0.492
		(0.150)		(0.396)		(0.352)
$Trend_t \times Super$		-0.167		0.176		-0.226
		(0.181)		(0.491)		(0.348)
Window before the event	[τ-10, τ-1]	[τ-10, τ-1]	[τ-10, τ-1]	[τ-10, τ-1]	[τ-10, τ-1]	[τ-10, τ-1]
Adjusted R^2	0.977	0.977	0.981	0.981	0.984	0.984
Observations	1,840	1,841	2,248	2,249	3,603	3,603
Product type FE	yes	yes	yes	yes	yes	yes
Station FE	yes	yes	yes	yes	yes	yes

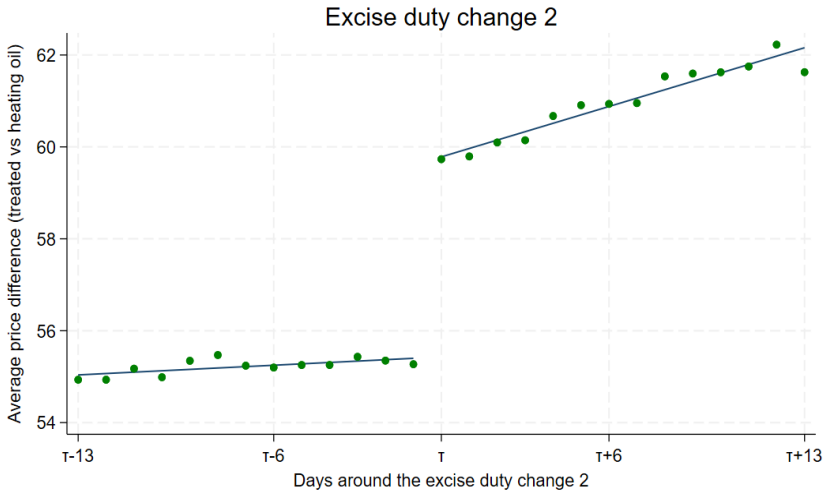
Parallel Trends BEFORE any changes

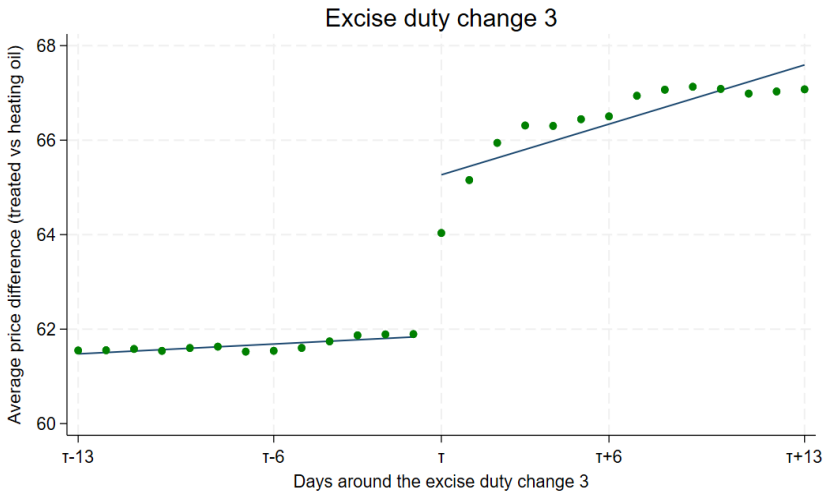
TABLE A3 - PARALLEL TREND TESTS (NON-PARAMETRIC)

VARIABLES Excise change	(1) $Price_{jgt}$ 1st Excise	(2) $Price_{jgt}$ 2nd Excise	(3) $Price_{jgt}$ 3rd Excise
Day(τ-10) × Treat	-1.257	-2.868	-1.569
	(0.943)	(4.570)	(2.056)
Day(τ-9) × Treat	-0.601	1.170	-1.007
	(1.004)	(1.923)	(1.932)
Day(τ-8) × Treat	0.032	1.025	-0.660
	(0.759)	(1.921)	(1.908)
Day(τ-7) × Treat	0.270	-1.270	-2.188
	(0.613)	(1.287)	(1.899)
Day(τ-6) × Treat	-0.659	-1.600	-2.072
	(0.574)	(1.143)	(1.425)
Day(τ-5) × Treat	-0.669	-1.196	-2.203*
	(0.525)	(0.966)	(1.160)
Day(τ-4) × Treat	-0.109	-1.196	-1.389*
	(0.261)	(0.966)	(0.786)
Day(τ-3) × Treat	-0.050	0.608	-0.321**
	(0.255)	(0.937)	(0.149)
Day(τ-2) × Treat	0.105	0.715	-0.070
	(0.107)	(0.649)	(0.071)
Joint F-test (p-value)	0.629	0.209	1.397
	(0.432)	(0.650)	(0.241)
Window before the event	[τ-10, τ-1]	[τ-10, τ-1]	[τ-10, τ-1]
Observations	1,840	2,248	3,603
Within R^2	0.977	0.981	0.984
Day FE	yes	yes	yes
Product type FE	yes	yes	yes
Station FE	yes	yes	yes

DiD in pictures







Complete pass-through in Athens

TABLE 4: EXCISE DUTY PASS-THROUGH

	(1)	(2)	(3)	(4)
Estimation method	FE	FE	FE	FE
Dependent variable	$Price_{jgt}$	$Price_{jgt}$	$Price_{jgt}$	$Price_{jgt}$
Sample	1st excise	2nd excise	3rd excise	All excise periods
Tax	0.902***	0.969***	0.921***	0.947***
	(0.029)	(0.068)	(0.048)	(0.044)
Observations	368	458	756	1,582
Within R^2	0.923	0.778	0.767	0.935
Station × Product Type FE	yes	yes	yes	yes
Day FE	yes	yes	yes	yes
Excise*Station FE				yes
Excise*Type FE				yes
F-test (*p-value*)				
Tax = 1	11.66	0.210	2.751	1.43
	0.002	*0.652*	*0.101*	*0.232*

Higher pass-through for diesel than unleaded

TABLE A4 - PASS-THROUGH AND PRODUCT HETEROGENEITY

	(1)	(2)	(3)	(4)
Estimation method	FE	FE	FE	FE
Dependent variable	$Price_{jgt}$	$Price_{jgt}$	$Price_{jgt}$	$Price_{jgt}$
Sample	1st Excise	2nd Excise	3rd Excise	All Excise periods
tax*Unleaded95	0.935***	1.044***	0.886***	0.971***
	(0.034)	(0.059)	(0.038)	(0.039)
tax*Unleaded100	0.855***	0.978***	0.979***	0.981***
	(0.042)	(0.078)	(0.088)	(0.063)
tax*Diesel	1.066***	1.060***	1.129***	1.111***
	(0.133)	(0.095)	(0.088)	(0.070)
tax*Super	0.983***	0.889***	0.971***	0.933***
	(0.050)	(0.151)	(0.054)	(0.087)
Observations	368	458	756	1,582
Within R^2	0.926	0.781	0.770	0.935
Station × Product Type FE	yes	yes	yes	yes
Day FE	yes	yes	yes	yes
Excise*Station FE				yes
Excise*Type FE				yes

Strong external validity of pass-through in Athens

- Average pass-through across all episodes is 0.947 (s.e. 0.044).

  Very high & statistically not different from one, i.e. complete.
- Consumers bear almost all the tax burden!

  In line with estimates for US state taxes on petroleum products (Marion and Muehlegger, 2011; Chouinard and Perloff, 2007; Doyle and Samphantharak, 2008; Alm, Sennoga and Skidmore, 2009)
- Diesel pass-through higher than for gasoline and complete.

  In line with the literature that finds a more inelastic demand for diesel than gasoline (Ajanovic, Dahl and Schipper, 2012; Karagiannis, Panagopoulos and Vlamis, 2015; Labandeira, Labeaga and Lopez-Otero, 2017; Fridstrøm and Østli, 2021).

Methodology

- Difference-in-Differences framework:

$$P_{jst} = \rho(n_m)Tax_{jt} + \lambda_t + \lambda_{js} + \varepsilon_{jst}$$

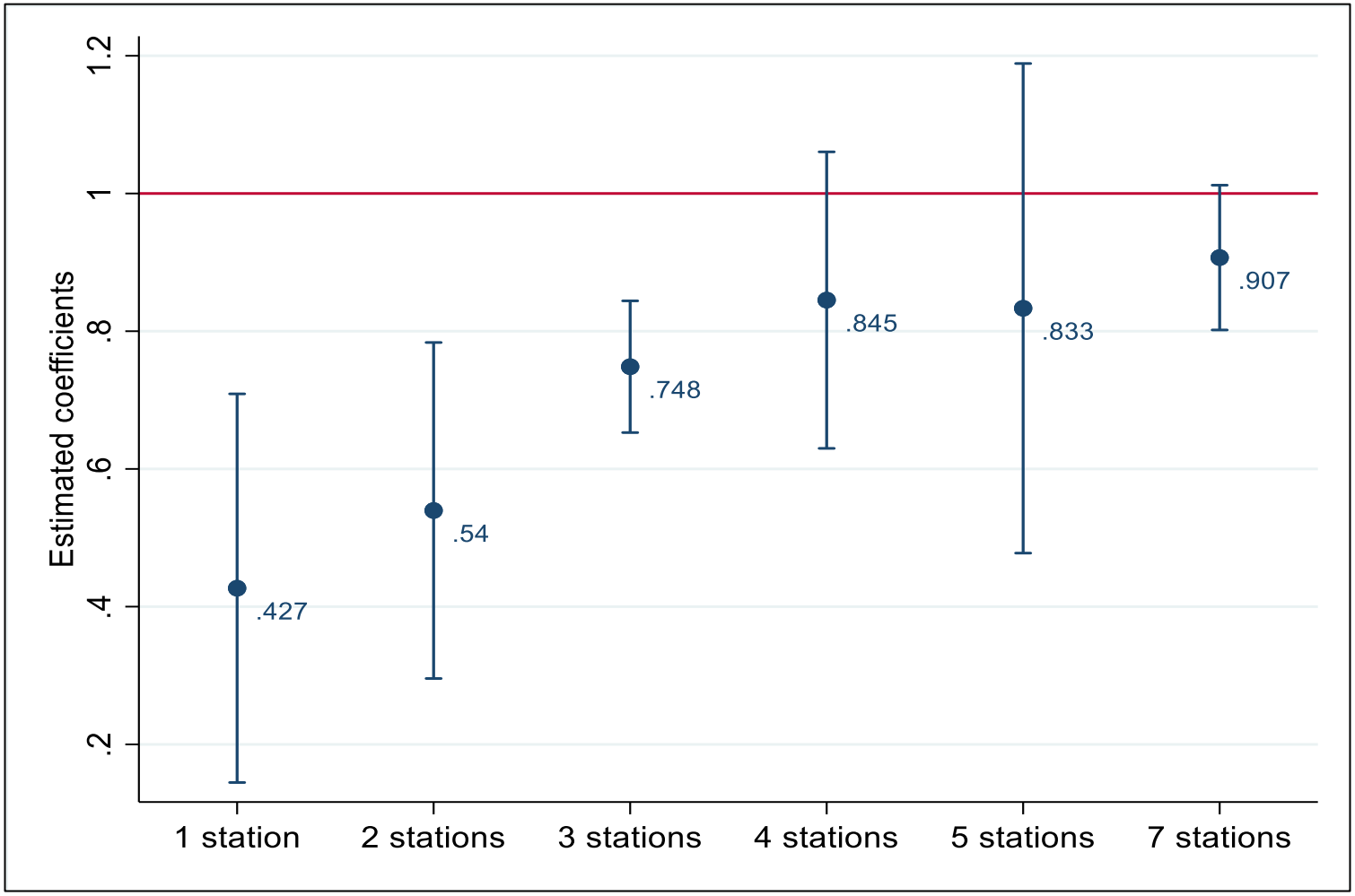
for product *j*, on market *m*, in gas station *s*, on day *t.*

- Interaction of Tax with n_m: $\rho(n_m) = \rho_0 + \rho_1 n_m + \rho_2 n_m^2$

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

❖ **Identification**: variation of competition across markets

Benchmark Greek islands: Positive & non-linear relationship on competition & pass-through



No impact of competition on pass-through

TABLE 5: PASSTHROUGH AND COMPETITION BASED ON RADIUS

	(1)	(2)	(3)	(4)	(5)
Estimation method	FE	FE	FE	FE	FE
Dependent variable	$Price_{jgt}$	$Price_{jgt}$	$Price_{jgt}$	$Price_{jgt}$	$Price_{jgt}$
Radius	0.1km	0.5km	1.0km	1.5km	2.0km
			PANEL A		
Tax_{it}	0.951***	0.953***	0.931***	0.966***	0.978***
	(0.047)	(0.051)	(0.052)	(0.061)	(0.062)
Tax_{it} × Number of competitors$_s$	-0.029	-0.003	0.002	-0.001	-0.001
	(0.091)	(0.019)	(0.004)	(0.003)	(0.002)
Within R^2	0.935	0.935	0.935	0.935	0.935
Observations	1,582	1,582	1,582	1,582	1,582
			PANEL B		
Tax_{it}	0.951***	0.946***	0.998***	1.095***	1.155***
	(0.047)	(0.050)	(0.081)	(0.098)	(0.143)
(times 100) Tax_{it} × Number of competitors$_s$	-0.029	0.008	-0.017	-0.019	-0.015
	(0.091)	(0.046)	(0.024)	(0.012)	(0.010)
(times 100)Tax_{it} × Number of competitors$_s^2$		-0.002	0.001	0.000	0.000
		(0.011)	(0.001)	(0.000)	(0.000)
Within R^2	0.935	0.935	0.935	0.935	0.935
Observations	1,582	1,582	1,582	1,582	1,582

No impact of competition on pass-through

TABLE 6: PASSTHROUGH AND COMPETITION BASED ON DRIVING DISTANCE

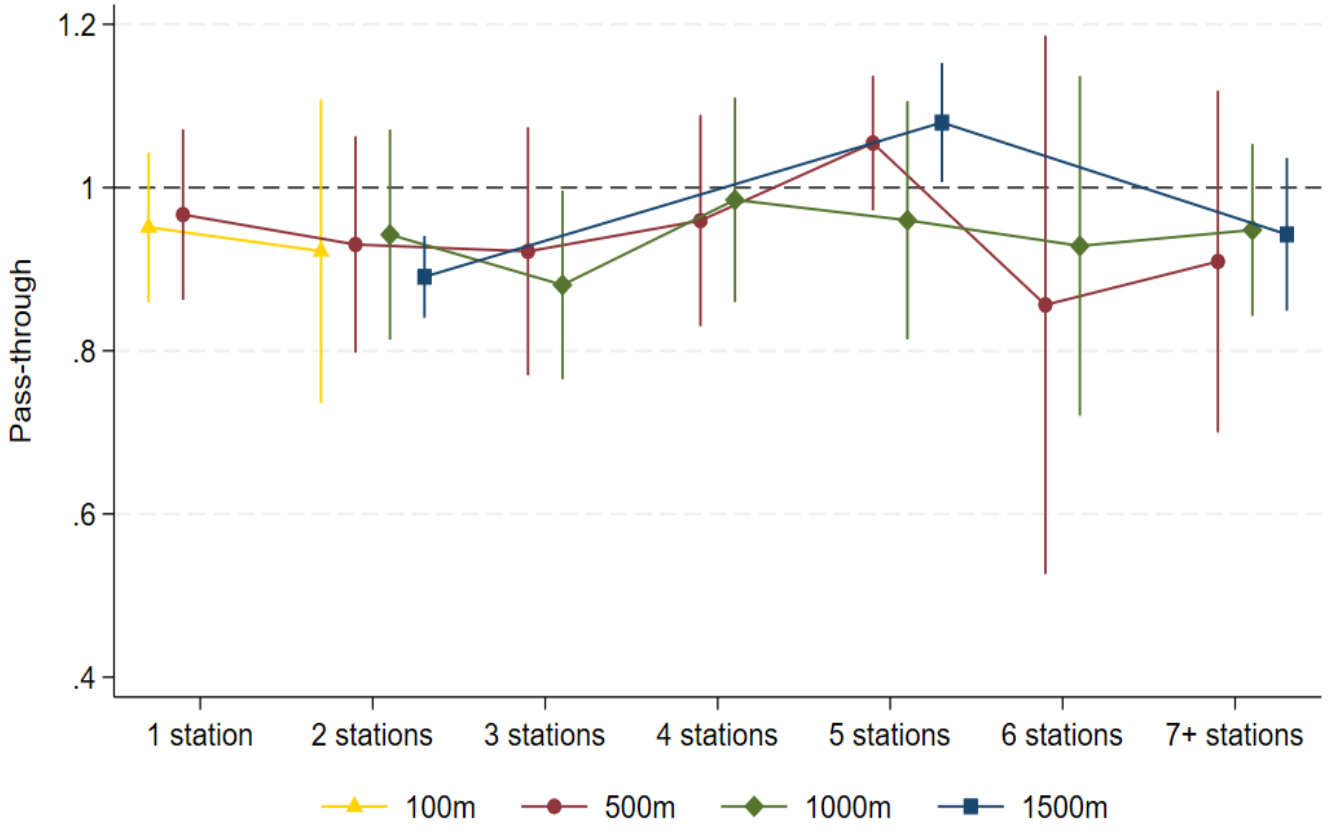
	(1)	(2)	(3)
Estimation method	FE	FE	FE
Dependent variable	$Price_{jgt}$	$Price_{jgt}$	$Price_{jgt}$
Driving distance	1km	1.5km	2km
	PANEL A		
Tax_{it}	0.975***	0.961***	0.948***
	(0.053)	(0.050)	(0.056)
(times 100)Tax_{it} × Number of competitors$_s$	-0.011	-0.002	-0.000
	(0.016)	(0.004)	(0.003)
Within R^2	0.935	0.935	0.935
Observations	1,582	1,582	1,582
	PANEL B		
Tax_{it}	0.975***	1.074***	1.083***
	(0.057)	(0.061)	(0.074)
(times 100)Tax_{it} × Number of competitors$_s$	-0.010	-0.040**	-0.024*
	(0.025)	(0.020)	(0.013)
(times 100)Tax_{it} × Number of competitors$_s^2$	-0.000	0.002**	0.001**
	(0.002)	(0.001)	(0.000)
Within R^2	0.935	0.935	0.935
Observations	1,582	1,582	1,582

No impact of competition on pass-through

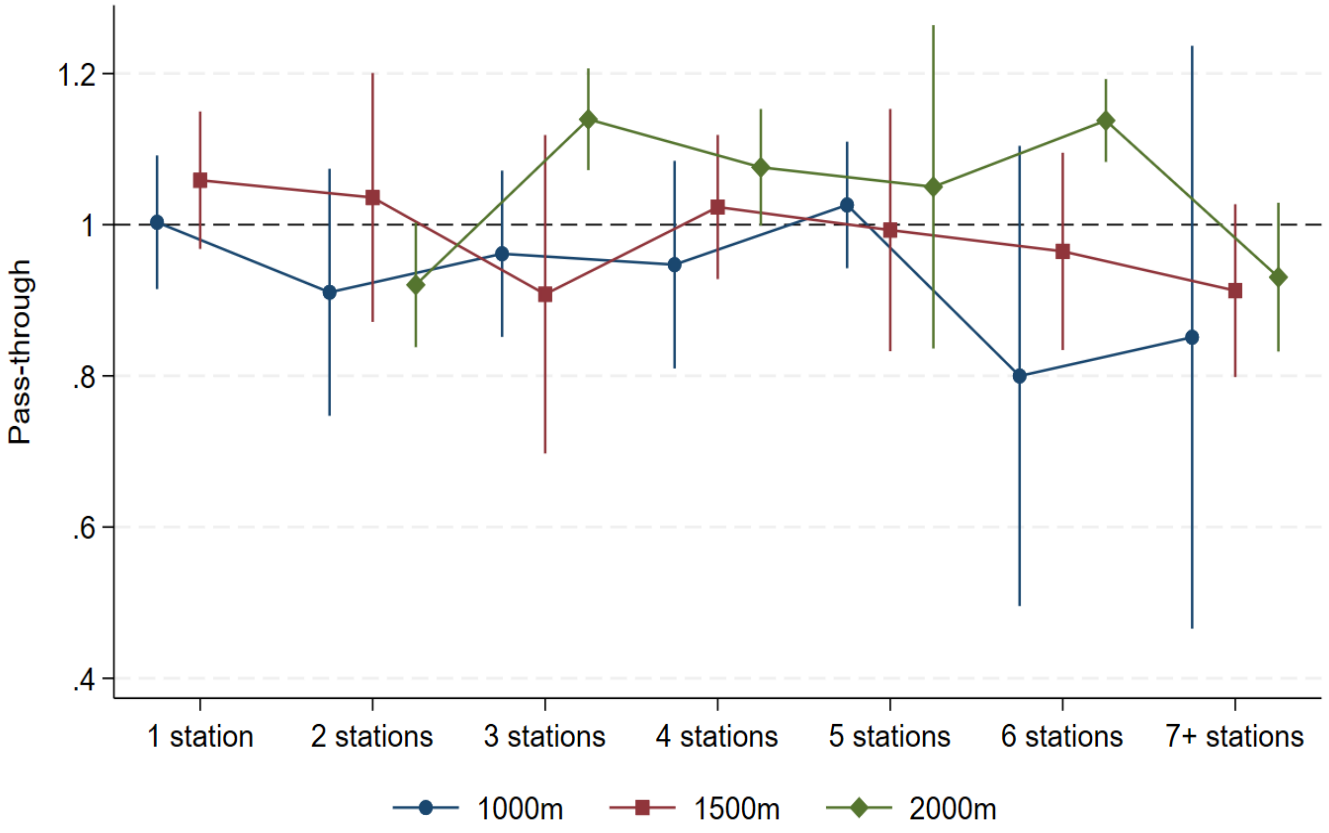
TABLE 7: PASSTHROUGH AND COMPETITION BASED ON TRAVELING TIME

	(1)	(2)	(3)
Estimation method	FE	FE	FE
Dependent variable	$Price_{jgt}$	$Price_{jgt}$	$Price_{jgt}$
Driving time	1min	2min	3min
	PANEL A		
Tax_{it}	0.951***	0.962***	1.026***
	(0.047)	(0.045)	(0.048)
(times 100)Tax_{it} × Number of competitors$_s$	-0.019	-0.014	-0.028
	(0.064)	(0.019)	(0.018)
Within R^2	0.935	0.935	0.935
Observations	1,582	1,582	1,582
	PANEL B		
Tax_{it}	0.953***	0.985***	1.014***
	(0.047)	(0.043)	(0.045)
(times 100)Tax_{it} × Number of competitors$_s$	-0.108	-0.085	-0.015
	(0.118)	(0.070)	(0.047)
(times 100)Tax_{it} × Number of competitors$_s^2$	0.069	0.023	-0.002
	(0.047)	(0.021)	(0.009)
Within R^2	0.935	0.935	0.935
Observations	1,582	1,582	1,582

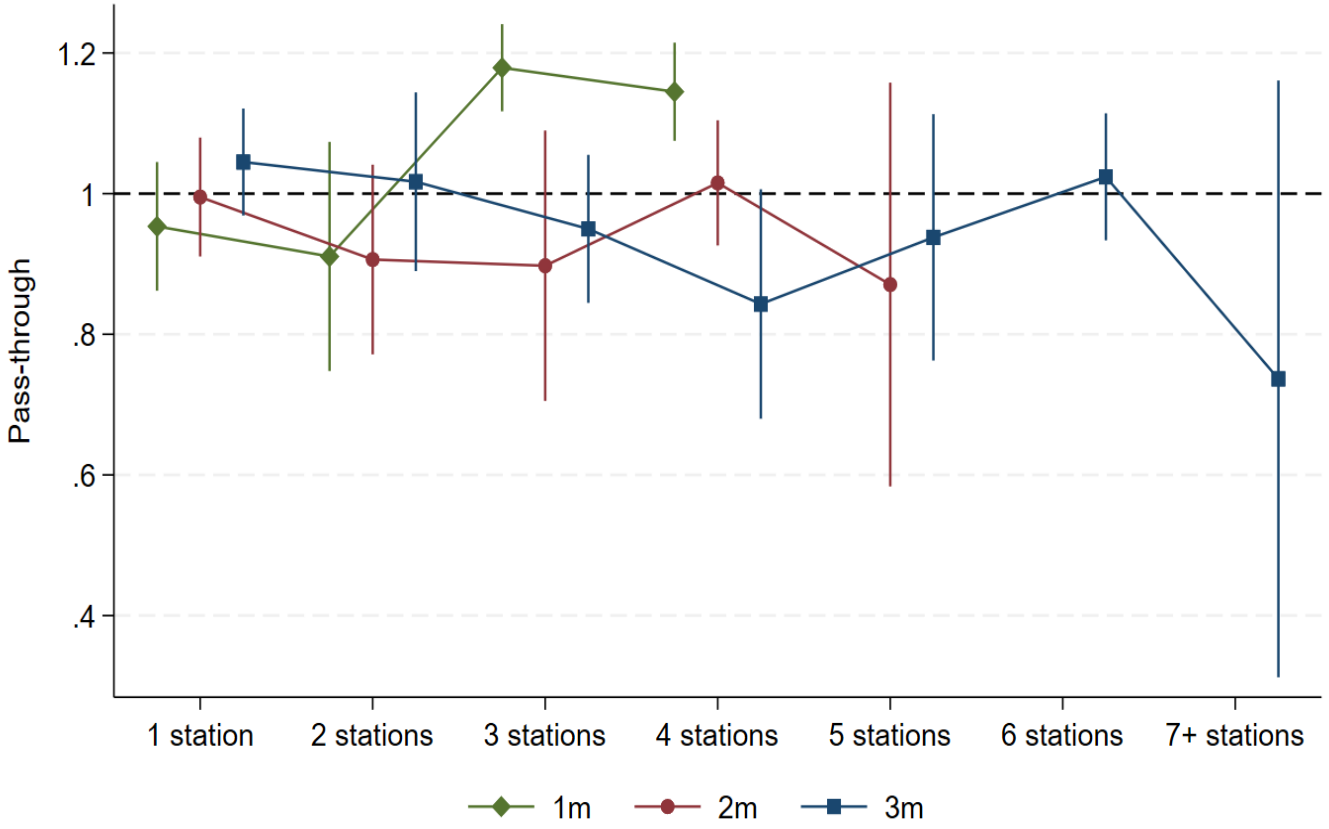
No impact of competition on pass-through (radius)



No impact of competition on pass-through (driving distance)



No impact of competition on pass-through (driving time)



Conclusions

- ✓ What is the “right” geographic market definition?
- ✓ Use Athens as an example of a large, urban area and divide it using different isodistance and isochrone market definitions into many local submarkets.
- ✓ Measure pass-though of three large and unannounced increases of the excise duty on petroleum products (gasoline, unleaded gasoline, diesel), while using heating diesel as a control group.
- ✓ Compare pass-through from local submarkets to Greek islands.
- ✓ Results imply that gas stations within the Athens metropolitan area react as if they all belong to the **same** geographic relevant market.
- ✓ Geographic market definitions based on arbitrary measures of distance across sellers are completely misguided and seriously underestimate the true substitutability → antitrust & research

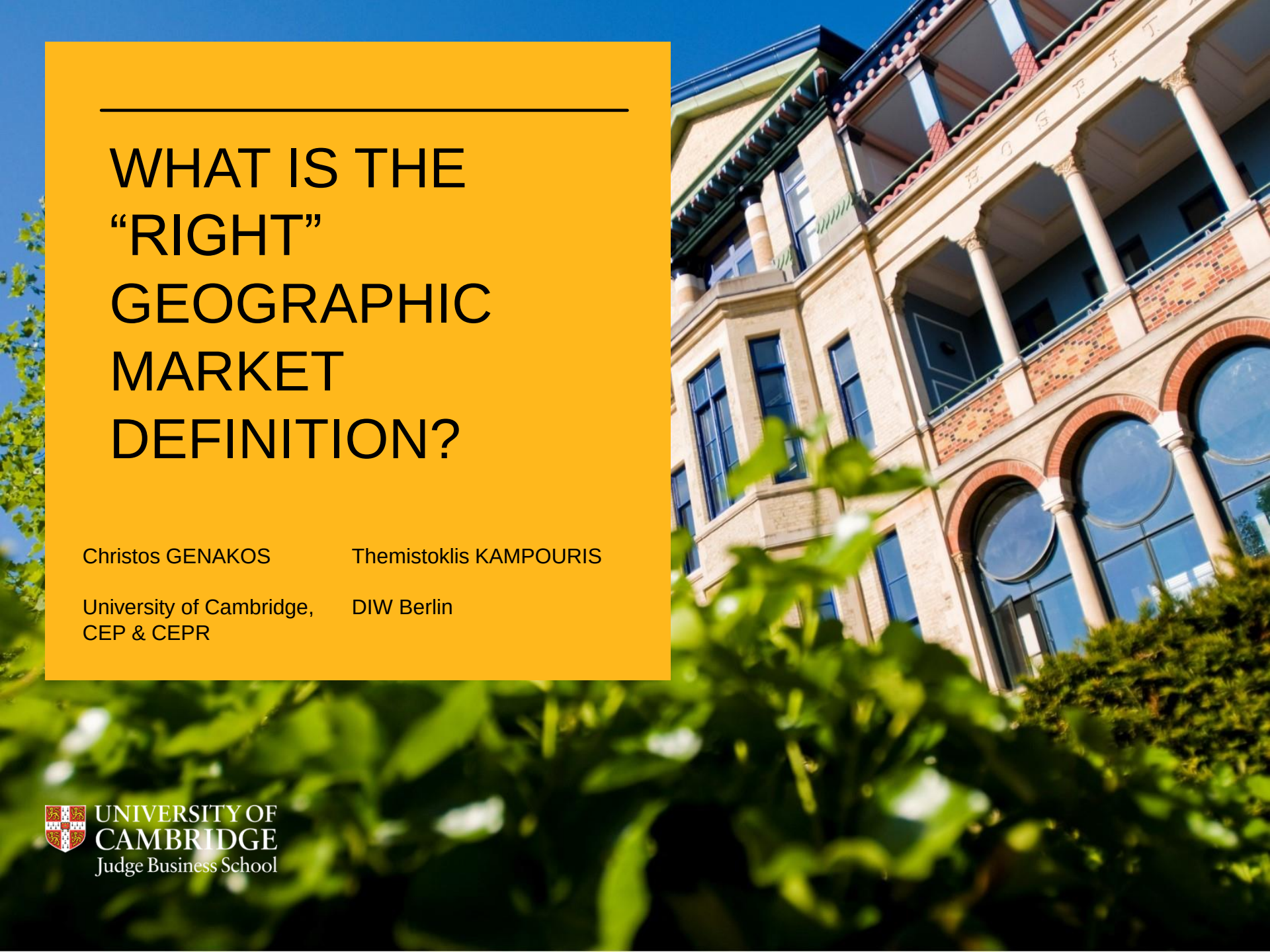
WHAT IS THE "RIGHT" GEOGRAPHIC MARKET DEFINITION?

Christos GENAKOS

University of Cambridge,
CEP & CEPR

Themistoklis KAMPOURIS

DIW Berlin



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