Evaluating the Impact of Price Caps. Evidence from the European Roam-like-At-Home Regulation

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Roam-Like-At-Home

15th June 2017: end of all roaming surcharges

Data and voice roaming consumption charged as if European travellers were consuming at home, without any additional charges

- Potentially large benefits to European consumers
- Ambiguous impact on operators
  - Decline in retail profits (outbound)
  - Increase in wholesale profits (inbound)
- Distributional effects
  - Between consumers across different countries
  - Between travelling and non-travelling consumers?
  - Between MNOs (own network) versus MVNOs (not own network)

$\Rightarrow$ Important implications for implementation of the internal market

Impact of the RLAH on welfare

Aim of the paper

Assess welfare and distributional effects of the RLAH regulation

- Theoretical model to evaluate various welfare effects: consumer surplus, retail profits and wholesale profits
- DiD identification strategy to estimate the causal impact of the RLAH regulation on retail and wholesale volumes

  $\Rightarrow$ **We provide evidence on various effects of price cap regulation, accounting for changes in demand.**

Relevant literature

- Wholesale access pricing in network industries
  - Theoretical: Armstrong (2001), Wright (2002), Lupi and Manenti (2009)
  - Empirical: Genakos and Valletti (2011, 2015)
- Price regulations in international context
  - General: Dubois, Gandhi and Vasserman (2019), Duch-Brown, Grzybowski, Romahn and Verboven (2020)
  - RLAH: Quinn, de Matos, Peukert (2022), Grzybowski and Munoz-Acevedo (2021)
- Methodology
  - Policy evaluation: Einav, Finkelstein and Cullen (2010), Hackmann, Kolstad and Kowalski (2015)
  - Consumer surplus bounds with unknown demand curvature: Kang and Vasserman (2022)

Outline

- Roaming market and regulations
- Theoretical model
- Empirical framework
- Empirical results and extensions

Functioning of the roaming market

Retail market (outbound traffic)

- MNOs and MVNOs offer roaming services to their customers travelling abroad
- They charge retail roaming price $p = p_{dom} + p_{sur}$
- They pay wholesale price for this outbound traffic w_{out}

Wholesale market (inbound traffic)

- MNOs provide roaming access to (travelling customers of) foreign operators
- They charge wholesale price for this inbound traffic w_{in}
- They incur a marginal cost c for this.

Price regulations

Before Roam-Like-At-Home

- Roaming retail surcharges regulated through tightening price caps
- Wholesale prices result of bilateral agreements and caps

Roam-Like-At-Home in 2017

- Abolition of retail roaming charges, $p_{sur} = 0$
- Wholesale price cap to protect fragile actors (e.g. MVNOs)
- Fair Use Policy controls to prevent and sanction misuse
- Sustainability Derogation may exceptionally be granted

Theoretical model: set-up

Domestic welfare from an operator's roaming service at $p = p_{dom} + p_{sur}$:

$$W = \underbrace{\int_p^\infty q_{out}(u)du}_{CS} + \underbrace{(p - w_{out})\, q_{out}(p)}_{\pi_{retail}} + \underbrace{(w_{in} - c)\, q_{in}}_{\pi_{wholesale}}. \quad (1)$$

(outbound traffic) (outbound traffic) (inbound traffic)

Assumptions

- No competition for subscribers through roaming prices
- No substitution between data and voice
- No waterbed effects on domestic services $\rightarrow$ validation exercise
- No external effects $\rightarrow$ lower bound on effects

$\Rightarrow$ Consider welfare per operator and service type and aggregate

Theoretical model: impact of RLAH

Regulatory events

- Retail roaming price drops from $p^0 = p_{dom} + p_{sur}$ to $p^1 = p_{dom}$

  $\rightarrow$ Roaming traffic may increase from q^0_{out} to q^1_{out}, and q^0_{in} to q^1_{in}

- Wholesale prices may drop from w^0_{out} to w^1_{out}, and from w^0_{in} to w^1_{in}
- Marginal costs may change from c^0 to c^1

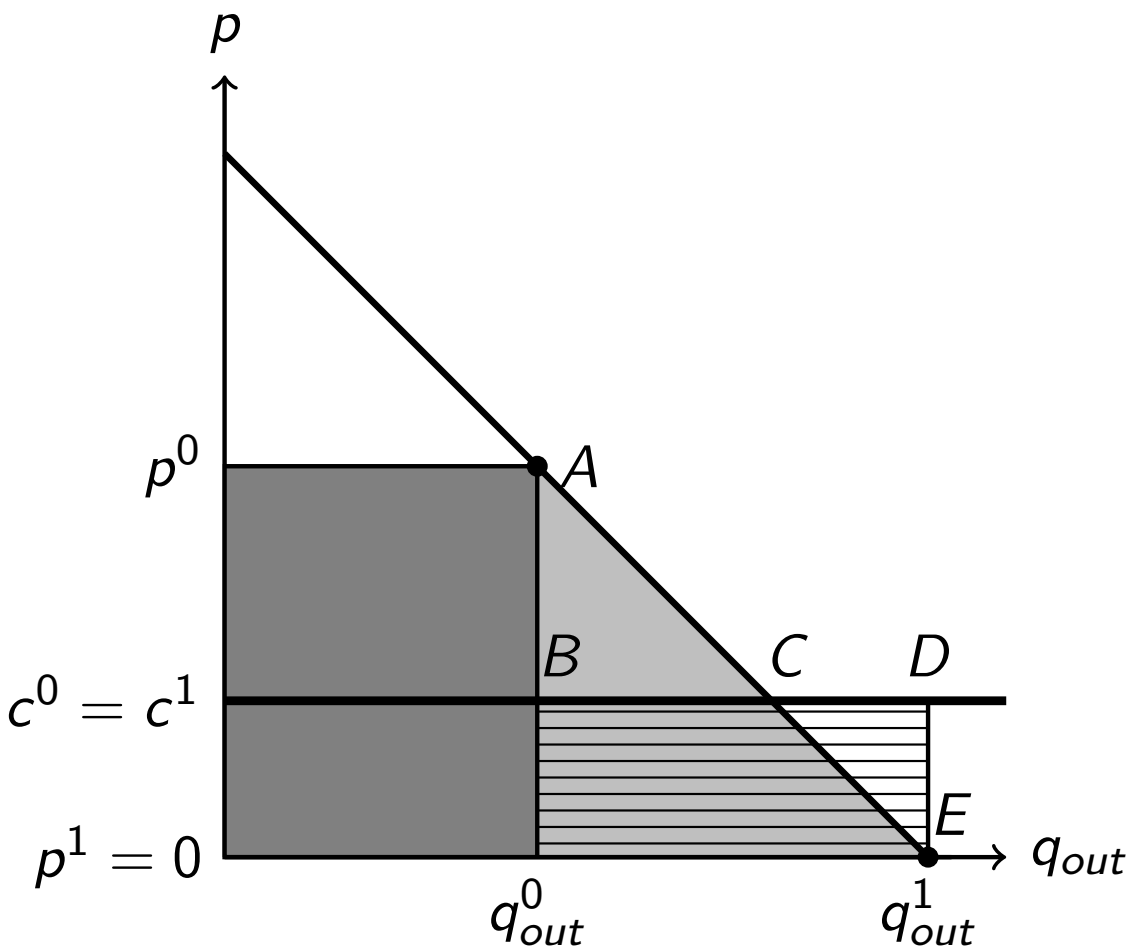
Change in welfare

$$\begin{aligned}
\Delta W &= \Delta CS + \Delta \pi_{retail} + \Delta \pi_{wholesale} \\
&= \int_{p^1}^{p^0} q_{out}(u)du \\
&\quad -(p^0 - p^1)q^0_{out} - (w^1_{out} - p^1)\Delta q_{out} - q^0_{out}\Delta w_{out} \\
&\quad +\Delta r_{in} - c^1 \Delta q_{in} - q^0_{in}\Delta c.
\end{aligned}$$

Illustration: wholesale balancedness and linear demand

Consumers unambiguously gain

Welfare increases if $ABC > CDE$



Consumer surplus

- To calculate $\Delta CS = \int_{p^1}^{p^0} q_{out}(u)du$, need to know demand curvature
  - Linear demand

$$\Delta CS^{lin} = (p^0 - p^1)q^0_{out} + \frac{1}{2}(p^0 - p^1)(q^1_{out} - q^0_{out})$$

  - Constant elasticity demand

$$\Delta CS^{ces} = \frac{(p^0 q^0_{out} - p^1 q^1_{out})\log(p^0/p^1)}{\log(p^0 q^0_{out}) - \log(p^1 q^1_{out})}$$

- Kang and Vasserman (2022) bounds for families of demand functions
  - $\Delta CS \in (\Delta CS^{ces}, \Delta CS^{lin})$ for convex demand functions satisfying Marshall's second law
  - This is conservative if demand is actually concave
- Varian (1985) absolute lower and upper bounds if demand is perfectly inelastic or elastic at (p^0, q^0_{out})

Empirical approach

DiD strategy to identify impact of RLAH on traffic and wholesale revenues

- RLAH applies ONLY to consumers travelling within the EEA
- RLAH does not apply to roaming outside the EEA

$\Rightarrow$ we exploit this discontinuity in the application of the RLAH

Treated units: volumes and revenues related to each operator's EEA traffic

Control units: volumes and revenues related to each operator's RoW traffic

Identification strategy: DiD model

Estimating equation for $k = \{voice, data\}$

$$\ln Y_{ist}^k = \beta_i^k \times (EEA \times Post)_{st}^k + \gamma_{is}^k + \theta_t^k + \varepsilon_{ist}^k$$

- i refers to national operator operating in its own country
- s refers to the treatment area, EEA or RoW
- $(EEA \times Post)_{st}$ is dummy variable equal to one if the observation concerns the treatment group after the regulation
- γ_{is} are operator-area fixed effects
- θ_t are quarter fixed effects

Start with homogeneous effects ($\beta_i^k = \beta^k$), then allow for heterogeneity

Data

- Period survey reports on international roaming from Body of European Regulators for Electronic Communications (BEREC)
- Roaming volumes and revenues 10 quarters (2016q4 to 2019q1)
- 28 EEA countries (26 EU plus UK and Norway)
- 105 operators: 81 MNOs and 24 MVNOs

Descriptive statistics

Table: Summary statistics of roaming outcome variables.

	Intra-EEA				RoW			
	Pre-RLAH		Post-RLAH		Pre-RLAH		Post-RLAH	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Retail Voice Volumes	21.524	29.128	45.703	63.784	2.672	5.223	3.421	9.203
Retail Voice Revenues [a]	0.964	3.343	-	-	2.069	4.537	1.729	3.832
Retail Voice Price	0.046	0.154	-	-	0.764	1.351	-	-
Wholesale Voice Volumes	28.832	39.591	59.514	84.374	3.249	5.760	4.209	7.538
Wholesale Voice Revenues	0.905	1.424	1.330	2.001	0.581	1.210	0.534	1.097
Wholesale Inbound Voice Price	0.031	0.017	-	-	0.179	0.109	-	-
Retail Data Volumes	0.139	0.244	0.823	1.321	0.018	0.063	0.048	0.161
Retail Data Revenues [a]	1.340	3.040	0.032	0.139	2.686	6.495	3.375	8.494
Retail Data Price	9.657	33.198	-	-	145.847	420.542	-	-
Wholesale Data Volumes	0.192	0.254	1.080	1.677	0.050	0.177	0.090	0.198
Wholesale Data Revenues	1.871	2.812	3.199	5.210	0.958	1.919	1.240	2.928
Wholesale Inbound Data Price	9.732	6.426	-	-	19.345	97.368	-	-

Note: Revenues are in million Euros. Voice volumes are in million minutes of calls. Data volumes are in million GB.

Baseline results

Table: Empirical results

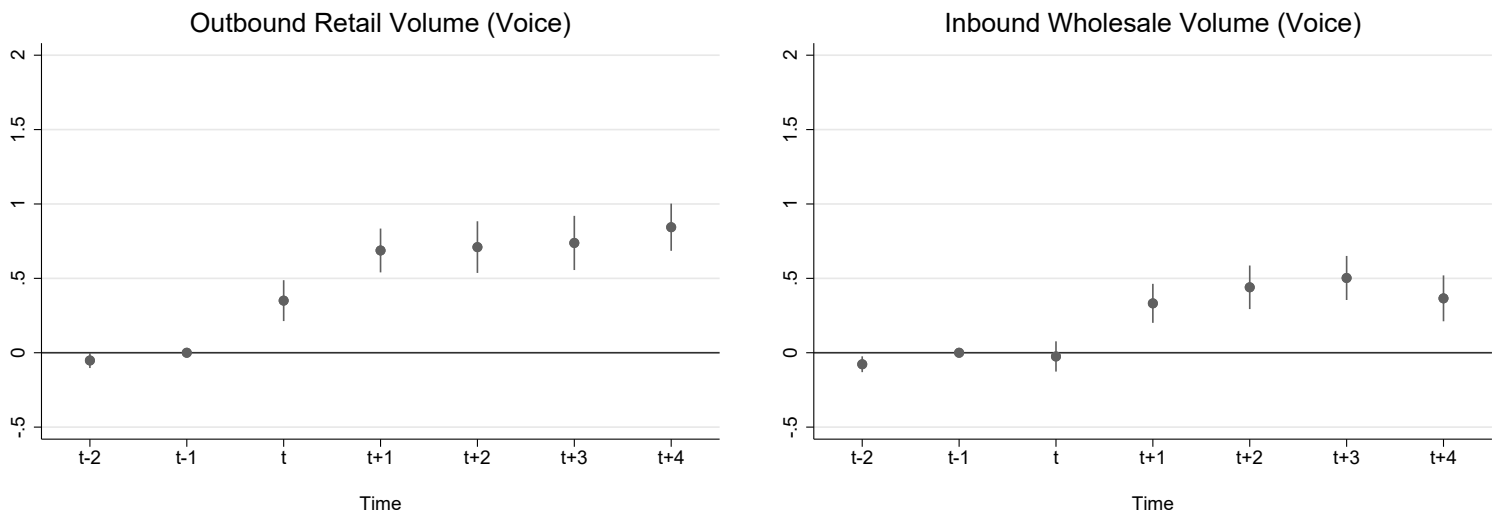
	Voice			Data		
	Outbound Retail Vol.	Inbound Whol. Vol.	Inbound Whol. Rev.	Outbound Retail Vol.	Inbound Whol. Vol.	Inbound Whol. Rev.
EEA X Post	0.770***	0.410***	0.450***	1.244***	0.643***	0.274***
	(0.074)	(0.062)	(0.064)	(0.152)	(0.119)	(0.092)
R-squared	0.981	0.976	0.946	0.970	0.953	0.907
Observations	2,100	1,740	1,740	2,100	1,740	1,740

Note: Clustered robust standard errors in parentheses. Clusters defined at country and operators' level.
*** p<0.01, ** p<0.05, * p<0.1

- Strong impact on retail and wholesale traffic
- Strongest impact on data services

Common trend/1

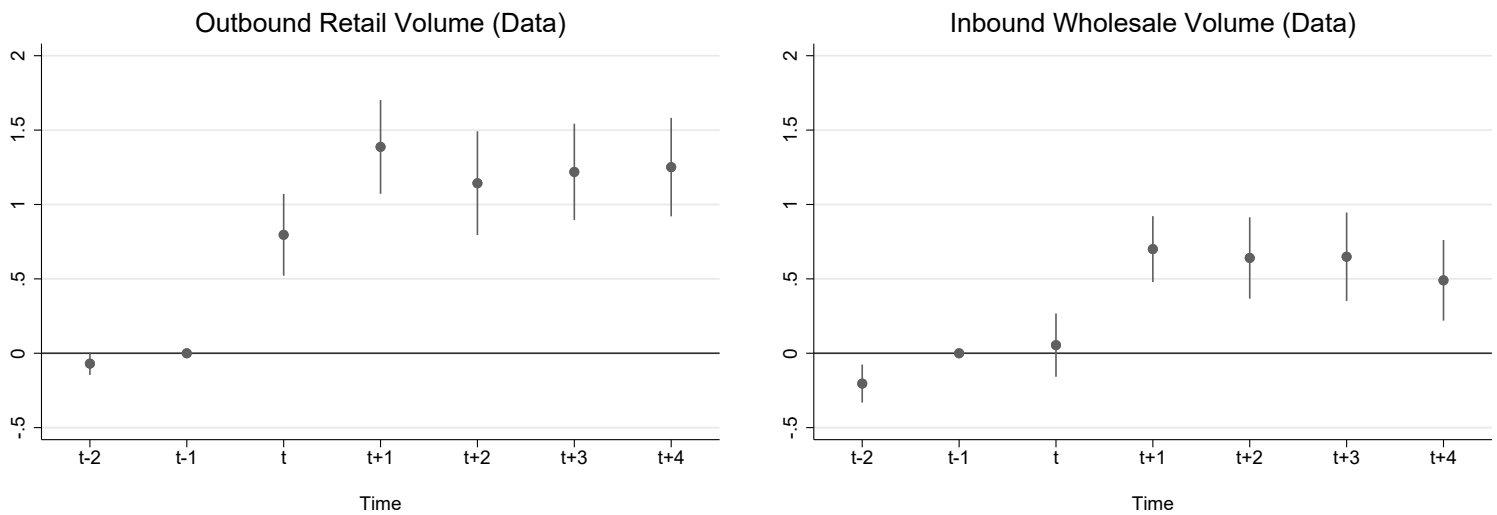
Figure: Event study - voice



- No significant change prior to RLAH regulation
- Effect almost immediate

Common trend/2

Figure: Event study - data



Heterogeneous effects/1

Table: Empirical results: by country group

	Voice			Data		
	Outbound Retail Vol.	Inbound Whol. Vol.	Inbound Whol. Rev.	Outbound Retail Vol.	Inbound Whol. Vol.	Inbound Whol. Rev.
EEA X Post X South	0.821***	0.575***	0.660***	1.365***	1.020***	0.515***
	(0.176)	(0.121)	(0.119)	(0.238)	(0.173)	(0.148)
EEA X Post X North	0.453***	0.193	0.165	0.692***	0.200	-0.102
	(0.105)	(0.129)	(0.108)	(0.204)	(0.212)	(0.169)
EEA X Post X West	0.745***	0.274***	0.346***	1.183***	0.404***	0.151
	(0.131)	(0.080)	(0.079)	(0.200)	(0.151)	(0.124)
EEA X Post X Central-East	1.021***	0.615***	0.651***	1.679***	0.994***	0.557***
	(0.106)	(0.096)	(0.089)	(0.198)	(0.137)	(0.138)
R-squared	0.981	0.976	0.946	0.970	0.953	0.907
Observations	2,100	1,740	1,740	2,100	1,740	1,740

Note: European Countries have been grouped as per the following classification: South (CY, EL, IT, MT, PT, ES); North (DK, EE, FI, LV, LT, NO, SE); West (AT, BE, FR, DE, IE, NL, UK); Central-East (BG, CZ, HR, HU, PL, RO, SK, SI).
Clustered robust standard errors in parentheses. Clusters defined at country and operators' level.
*** p<0.01, ** p<0.05, * p<0.1

- Strongest effects in Central-East and South (e.g. Hungary, Greece, Bulgaria)
- Weakest effects in North (e.g. Norway, Sweden, Estonia)

Heterogeneous effects/2

Table: Empirical results: by network type

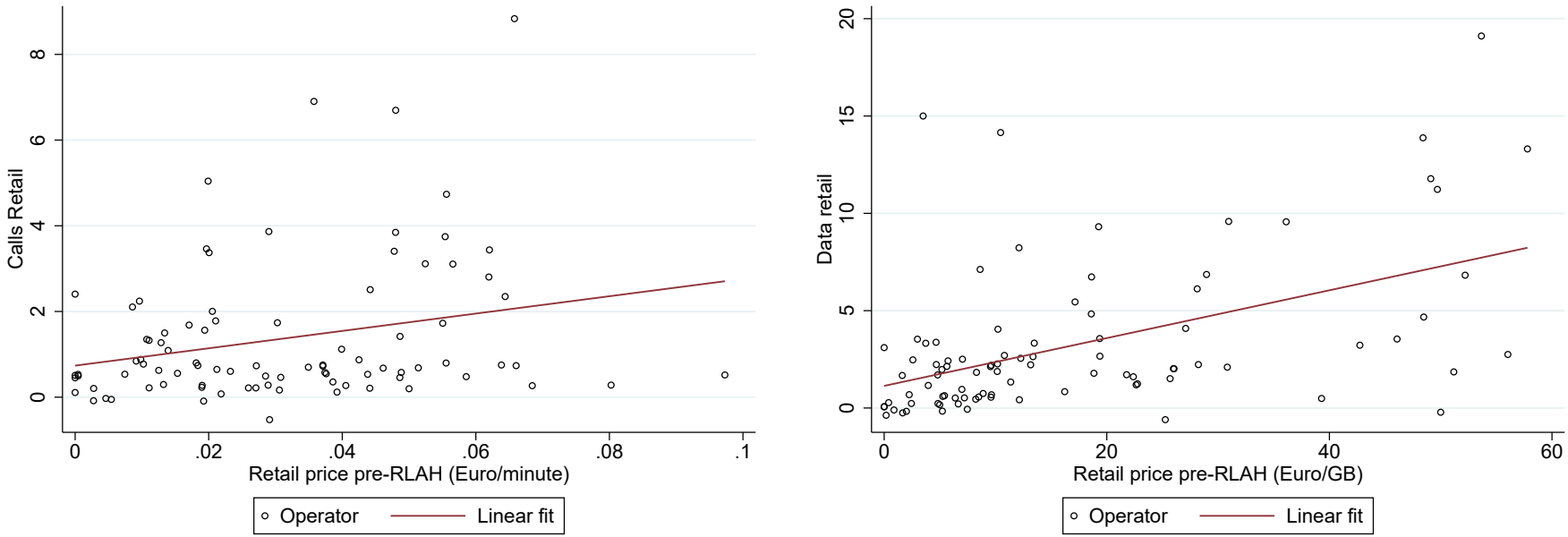
	Voice			Data		
	Outbound Retail Vol.	Inbound Whol. Vol.	Inbound Whol. Rev.	Outbound Retail Vol.	Inbound Whol. Vol.	Inbound Whol. Rev.
EEA X Post X MVNO	1.291***	-	-	2.004***	-	-
	(0.208)			(0.225)		
EEA X Post X MNO	0.639***	-	-	1.054***	-	-
	(0.081)			(0.160)		
R-squared	0.981			0.970		
Observations	2,100	1,740	1,740	2,100	1,740	1,740

Note: Clustered robust standard errors in parentheses. Clusters defined at country and operators' level.
*** p<0.01, ** p<0.05, * p<0.1

- Strongest effects for MVNOs (no own network)

Heterogeneous effects/3

Figure: Relationship between operators' treatment effects and retail prices pre-RLAH



Based on fully flexible operator-level effects (β_i^k)

- Strongest effects for operators with the highest roaming prices before the RLAH regulation

Bounds on Consumer Surplus Effects

Table: Consumer surplus changes by region

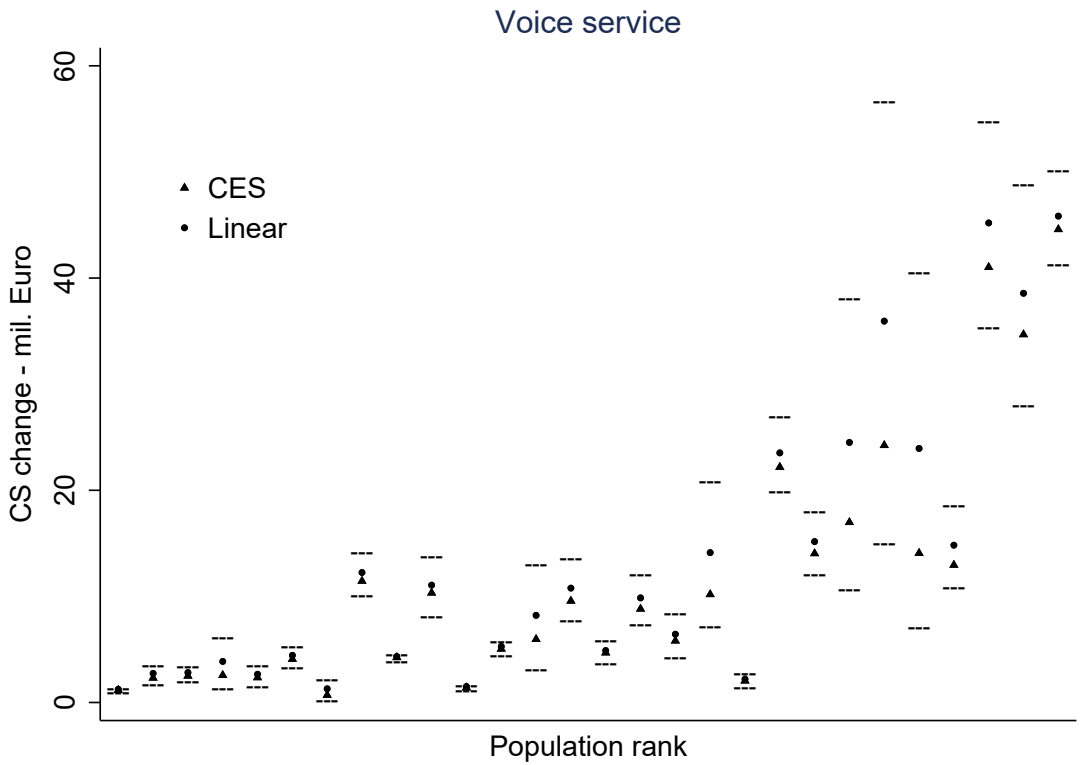
	Voice				Data			
	Lower bound	CES bound	Linear bound	Upper bound	Lower bound	CES bound	Linear bound	Upper bound
South	27	38	51	76	81	128	435	788
North	24	29	32	40	94	117	177	259
West	155	178	191	227	387	490	712	1037
Central-East	51	75	103	155	67	103	285	503
EEA	257	320	378	498	629	837	1608	2588

Note: "Lower bound" and "Upper bound": changes in CS if demand is perfectly inelastic or perfectly elastic at (p^0, q^0_{out}); "CES bound": lower bound for family of demand functions satisfying Marshall's second law of demand; "Linear bound": upper bound for family of convex demand functions.

- Substantial consumer surplus effects
- Strongest gains from new demand in Central-East and South

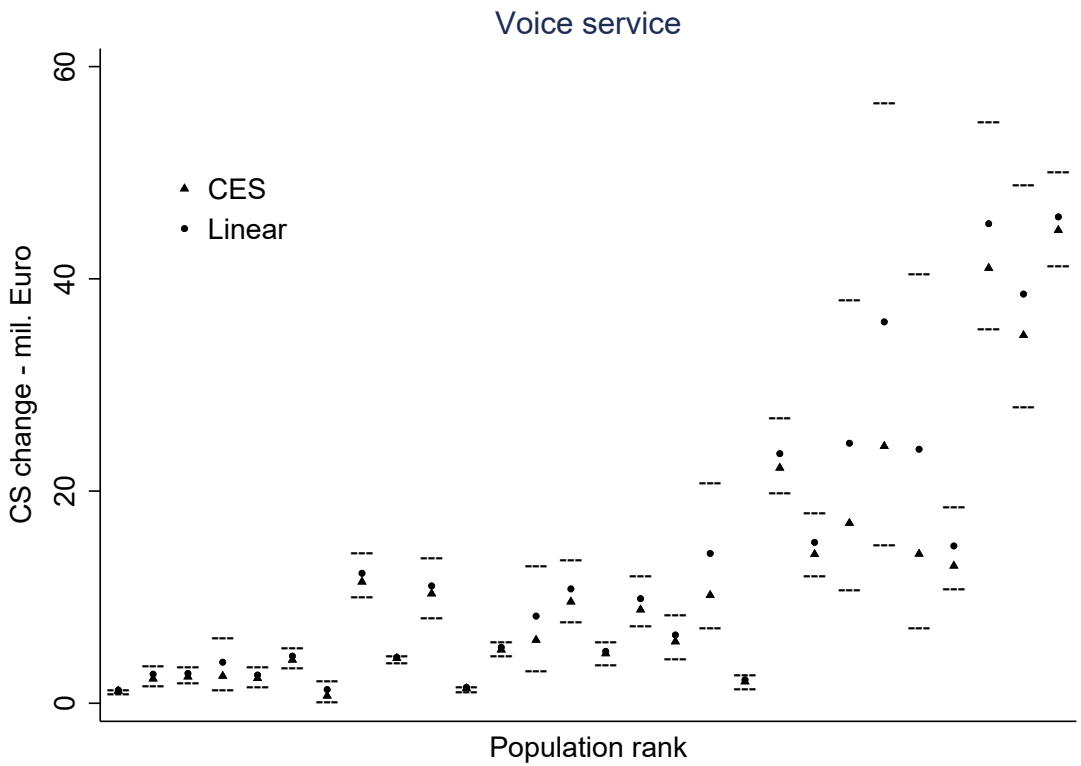
Bounds on Consumer Surplus Effects

Figure: Bounds on consumer surplus - voice service



Bounds on consumer surplus

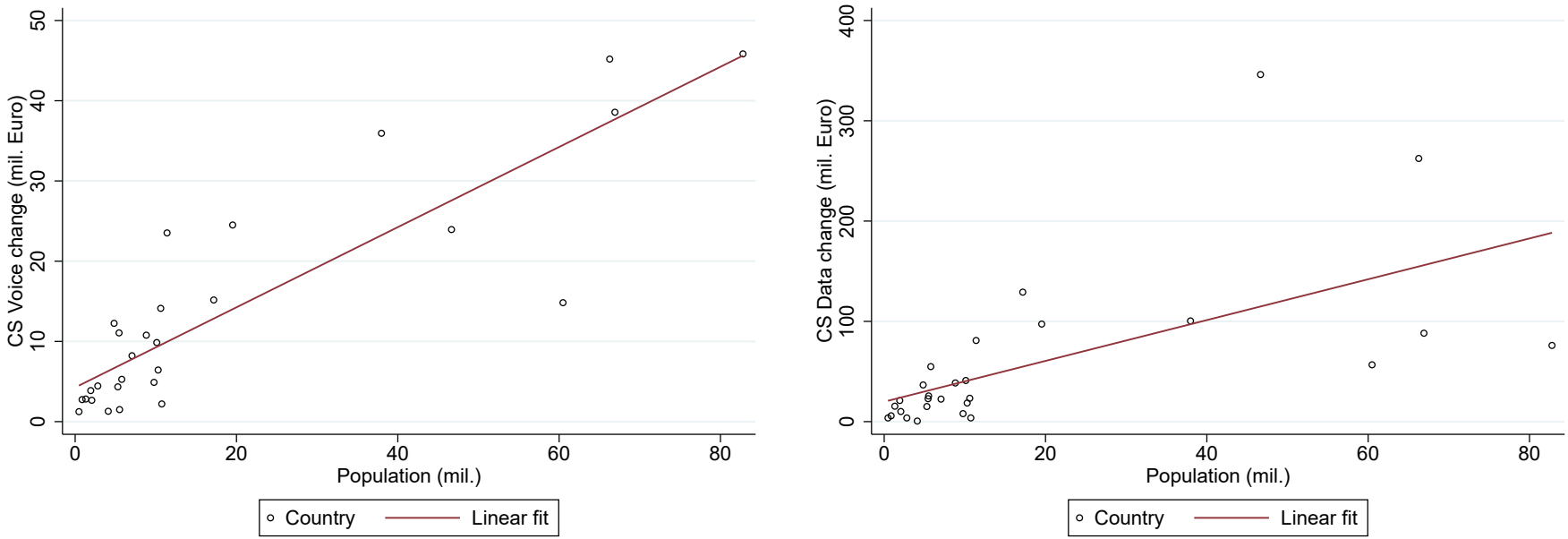
Figure: Bounds on consumer surplus - data service



- Fairly tight linear and CES bounds

CS and country characteristics/1

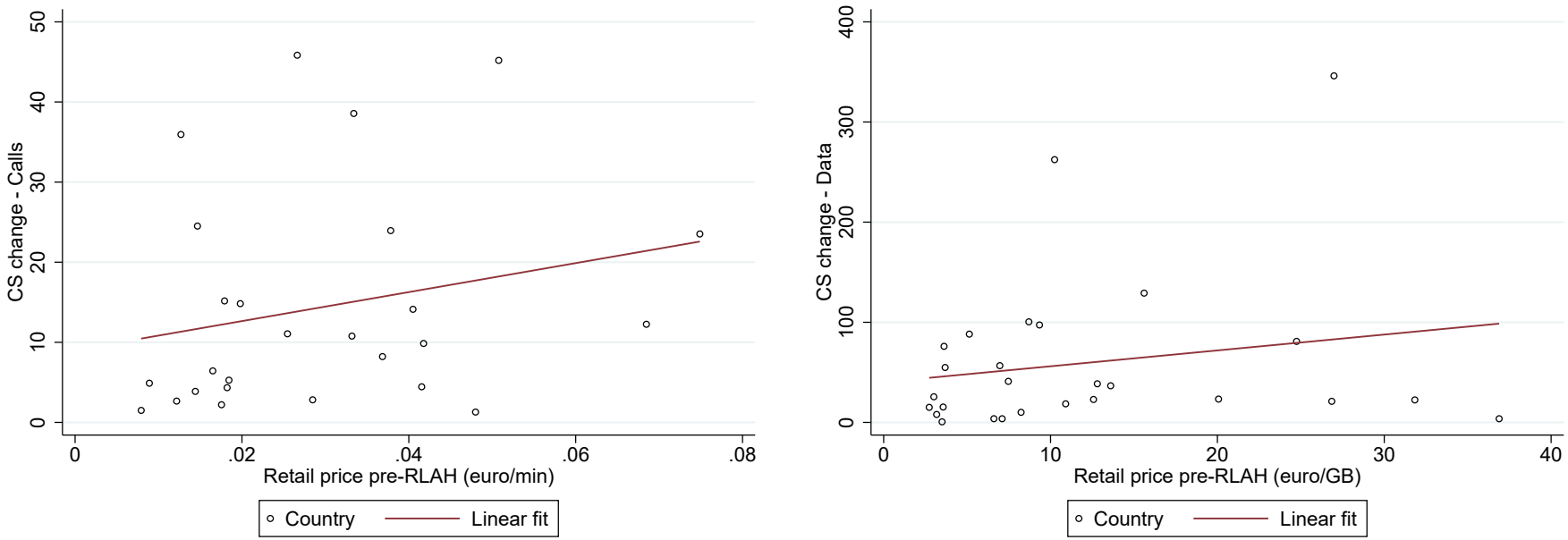
Figure: Relationship between CS and country population



- Consumer gains increasing in population size
- Small open economies tend to gain proportionately more

CS and country characteristics/2

Figure: Relationship between CS and retail prices pre-RLAH - country level



- Consumer gains higher when retail prices were higher before RLAH

Total Welfare Effects

Table: Total welfare effects

	Voice	**Data**	**Total**
Consumer Surplus	[320 , 378]	[837 , 1608]	[1157 , 1986]
Retail Profit (outbound)	-448	-825	-1273
Loss at given retail volume	-257	-629	-886
Extra loss from higher retail vol.	-224	-447	-671
Gain from reduced wholesale price	33	251	284
Wholesale Profit (inbound)	173	136	308
Wholesale revenues change	167	110	277
Loss from higher wholesale vol.	-31	-133	-164
Gain from reduced wholesale cost	36	159	195
Total Profit	-276	-689	-965
Total Welfare	[44 , 102]	[148 , 919]	[192 , 1021]

- Consumers gain between 1.2 and 2.0 bn Euro
- Retail profits drop by 1.3 bn Euro, wholesale profits increase by 0.3 bn Euro
- Welfare increases by between 0.2 and 1 bn Euro

→ Compatible with very high prices before RLAH due to double marginalization in competitive bottleneck

Waterbed in domestic market?

- Waterbed effect exists if price regulation in one market affects prices in other market (Genakos and Valletti, 2011)
- Here: do reduced roaming prices imply higher domestic prices?
- DiD for domestic retail price of basket j in OECD country c at time t

$$\ln P_{jct} = \beta_j \times (EEA \times Post)_{ct} + \phi_{jc} + \psi_{jt} + \varepsilon_{jct},$$

Waterbed effect in domestic market?

Table: Domestic prices regression results.

	Baskets	Outbound
High Coefficient	0.012	0.072
	(0.063)	(0.050)
Medium Coefficient	0.016	0.080
	(0.077)	(0.065)
Low Coefficient	0.106	0.170
	(0.089)	(0.088)
High Outbound		-0.091
		(0.090)
Medium Outbound		-0.097
		(0.107)
Low Outbound		-0.079
		(0.110)
Country-Basket FE	Yes	Yes
Basket-Period FE	Yes	Yes
R-squared	0.926	0.934
Observations	648	612
Jointly Zero	0.684	0.225
Outbound Zero		0.504

$\Rightarrow$ Difficult to detect waterbed effect. May be due to:

- weak relationship between domestic and roaming demand
- relatively small roaming market compared with domestic market

Concluding remarks

Summary

- RLAH regulation led to a massive increase in roaming volumes, both at the retail and wholesale level

  $\rightarrow$ Consumer gains much higher than pre-RLAH expenditures
- Heterogeneous consumer gains across countries
- Considerable total welfare effects
- Extension: no significant waterbed effects

Additional gains from price cap regulation?

- RLAH was just last step to zero-price caps
- Substantial tightening of price caps already took place during 2006–2017

  $\Rightarrow$ Overall gains from price cap regulation may be much larger!