Impact of Roaming Regulation on Revenues and Prices of Mobile Operators in the EU

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ERSA Seminar on IO and the Economics of Digitization Transformation
14 April 2020

Source: European Commission
https://ec.europa.eu/digital-single-market/en/roaming

Outline

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Introduction – Concepts

- **International mobile roaming**

  When you use your mobile phone while occasionally travelling outside the country where you live (outside the geographical coverage area of the home operator's network)

- **Roam Like At Home (RLAH)**

  No additional charges to use your mobile services abroad (within the EU): minutes of calls, SMS and megabytes of data are charged the same as at home

  - Fair Use policies and temporary sustainability derogations in some countries

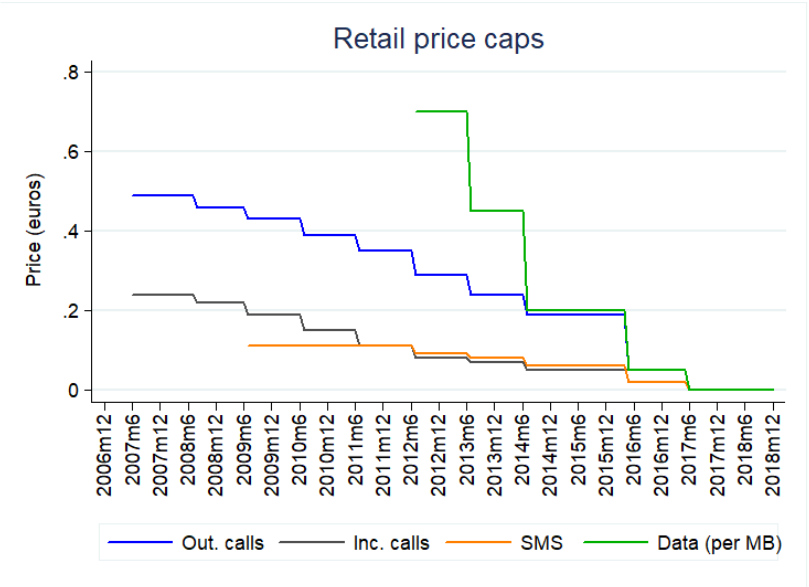
- **ARPU**

  Average Revenue per User of a mobile operator

Introduction – The EU roaming regulation

What?

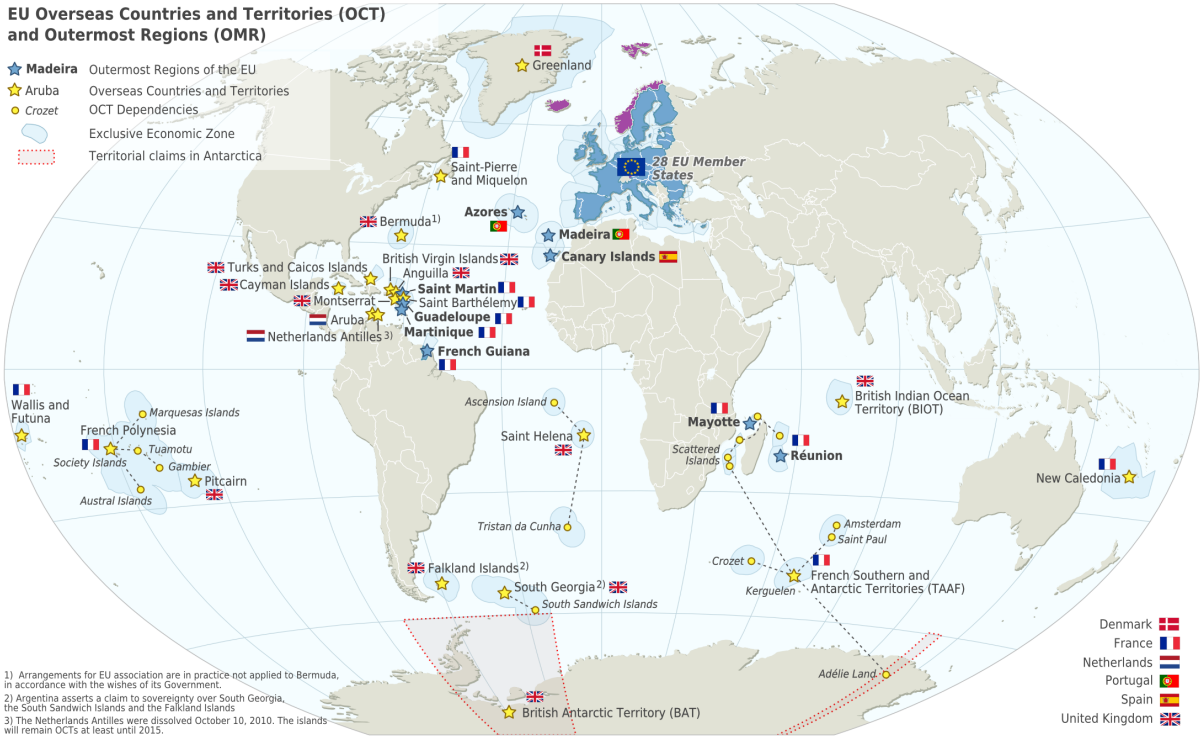
- Regulates wholesale and retail international roaming tariffs
- Started in 2007 and was applied gradually
- Last and decisive step: Roam-like-at-home (Adopted: October 2015; entered into force: June 2017)



Introduction – The EU roaming regulation

Where?

- EU member states + (Iceland, Liechtenstein and Norway)



Source: ROCCO + own adaptation

Introduction – The EU roaming regulation

Why?

- Since 1999: Complaints about excessive rates and lack of transparency for international roaming (Falch, 2012)
- 2005: The European Commission starts monitoring international roaming prices
- 2006 (EC impact assessment):
  - On average, international roaming prices 4 times higher than those of national mobile calls
  - On average, retail charge for a roamed call more than 5 times higher than the actual cost of providing wholesale service (50% higher than average inter-operator tariffs -IOT)

Introduction - The EU roaming regulation

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Underlying objectives

- Intensifying competition
- Market integration (digital single market)

Research Question

What is the impact of Roaming Regulation on Revenues and Prices of Mobile Operators in the EU?

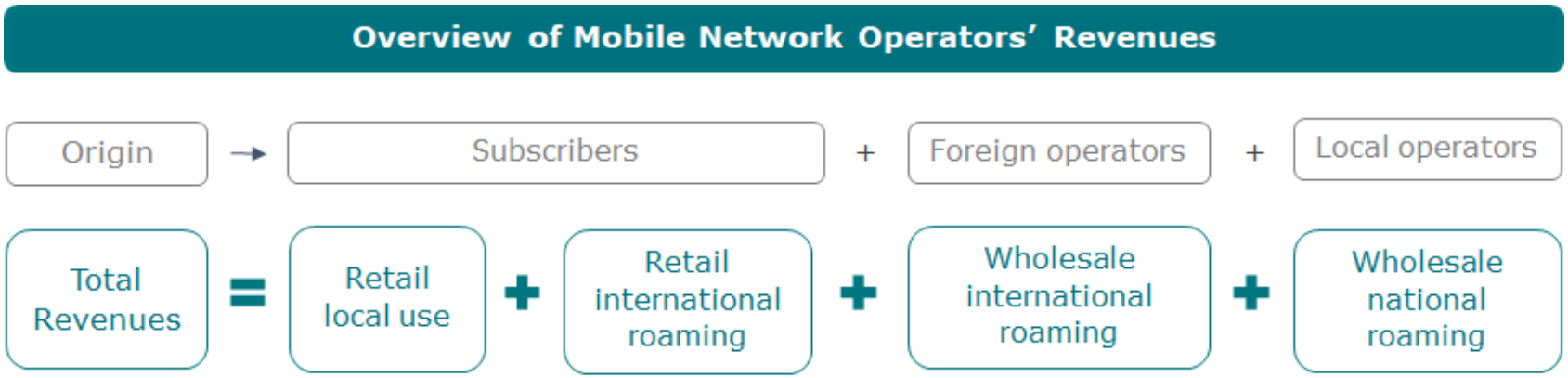
- We look at
  - Revenues: Average Revenue per User (ARPU)
  - Retail tariffs for mobile plans

Research Question – Why should we care?

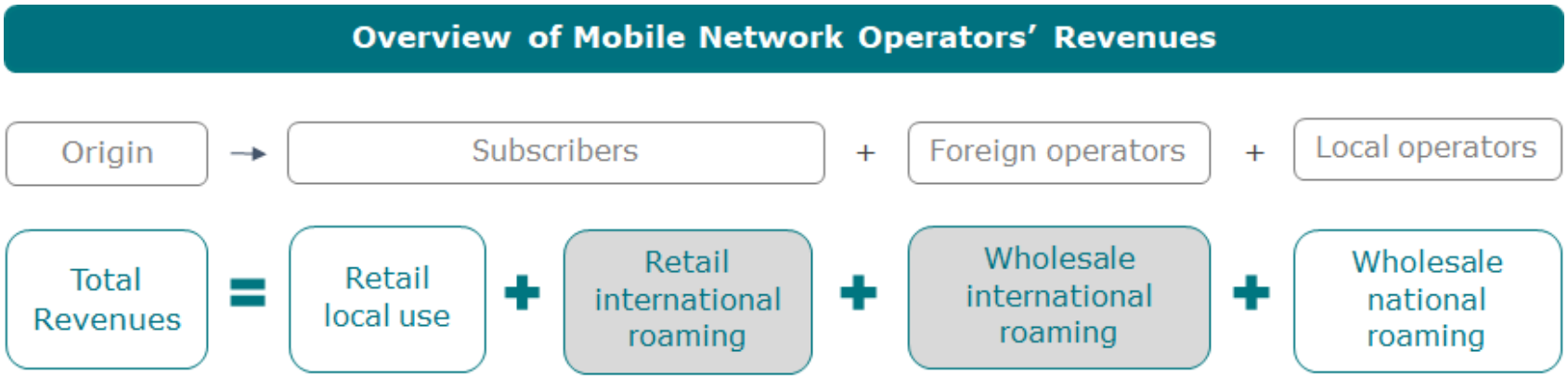
- Important effort towards a digital single market in the EU
  - The impact of the regulation has been the subject of discussion and debate for many years
  - Differences in costs, consumption and travel patterns across member states
  - Possible strategic reactions by operators
- Revenues (ARPU)
  - Protection of competition and investment incentives was one of the objectives discussed before the adoption of RLAH*
- Tariffs
  - Great benefits for travelling consumers, but possible unintended consequences for those who do not travel abroad (approx. 46% and 54% of mobile users in 2018, respectively)**
  - Protection of domestic consumers in visited and home markets was another objective discussed before the adoption of RLAH*

** BEREC, 2014*
*** Flash Eurobarometer 2018, The end of roaming charges one year later*

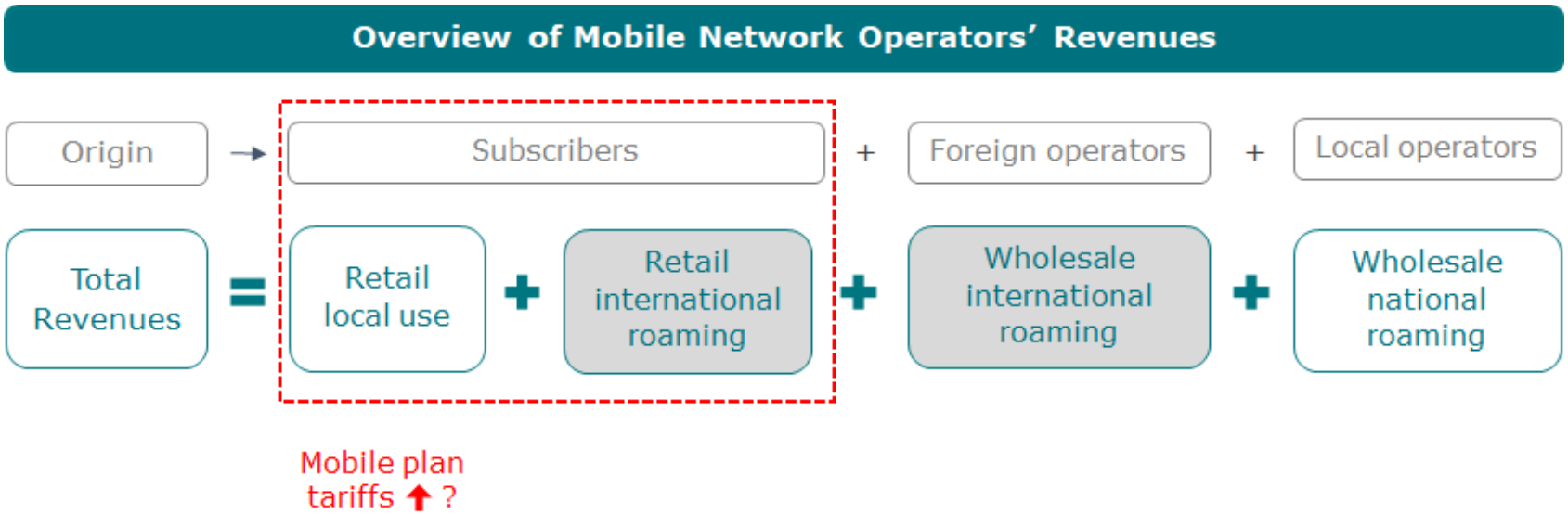
Research Question – The mechanism



Research Question – The mechanism



Research Question – The mechanism



Research Question - Our contribution

- First attempt to provide a rigorous empirical study on the regulation's impact on revenues and prices of mobile operators (detailed operator level data)

- Literature studying the impact of regulation on outcomes in telecommunications markets
  - Impact of fixed-to-mobile termination rates regulation on mobile retail prices: Genakos & Valletti (2011), Genakos & Valletti (2015)

- Literature on hedonic prices in telecommunications
  - Greenstein & McDevitt (2011), Wallsten & Riso (2014), Calzada & Martinez-Santos (2016), Nicolle et al. (2018)

Revenues

Revenues - Data

- OVUM
  - Operator level: ARPU, number of subscriptions
  - Country level: population
- GSMA
  - Complements on ARPU information
- World Bank
  - Purchasing Power Parities (PPP), exchange rates, GDP per capita, surface
- Own research
  - Entries, mergers and 4G commercial service launches
- EC + BEREC + OECD reports
  - Mobile termination rates (MTRs) - country level

$\Rightarrow$ Panel data

- Timeframe: 2004q1 - 2018q3 (quarterly)
- Level of observation: country-operator-quarter

Revenues - Empirical Approach

Difference-in-difference approach

Identification comes from a comparison through time of operators in countries that fall and do not fall under the roaming regulation

- 33 OECD countries (23 treated, 10 non-treated)
  - 111 operators (76 treated, 35 non-treated)
- Regulation in the EU since 2007q4

Revenues - Empirical Approach

Estimation equation

$$Log(y_{it}) = \alpha + \delta(G_i * R_t) + \eta_t + \lambda_i + \phi X_{it} + \varepsilon_{it}$$

Where

- y_{it} is the dependent variable, ARPU, for mobile operator i and quarter-year t
- G is an indicator variable denoting the treatment group (regulated countries)
- R is an indicator variable denoting the regulation period
- X is a vector of control variables
- λ is a vector of operator fixed effects
- η is a vector of quarter-year fixed effects

Revenues – Results

Table: OLS estimates of the impact of the EU roaming regulation on operators' Average Revenues per User

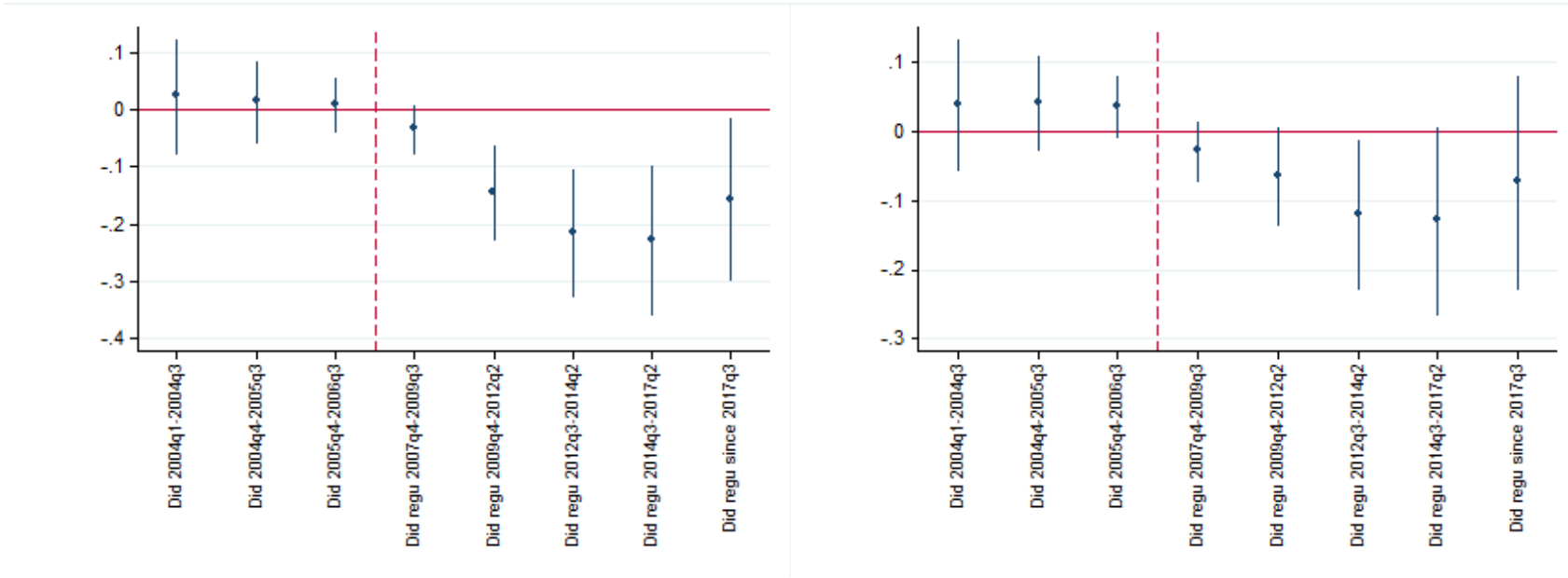
Dep. Variable	Log(ARPU euros)			Log(ARPU euros PPP)		
	(1)	(2)	(3)	(4)	(5)	(6)
Did regu since 2007q4	-0.224***	-0.183***	-0.135***	-0.134**	-0.113*	-0.0981**
	(0.0523)	(0.0572)	(0.0477)	(0.0555)	(0.0648)	(0.0482)
Log (GDP per capita)			0.479***			0.413*
			(0.111)			(0.211)
Log(Population Density)			0.0985			0.0868
			(0.357)			(0.373)
Entry			-0.0771			-0.121*
			(0.0619)			(0.0700)
4G Commercial Rollout			-0.00581			-0.0146
			(0.0245)			(0.0231)
Constant	3.262***	3.262***	-1.838	3.427***	3.426***	-1.044
	(0.0263)	(0.0255)	(1.947)	(0.0272)	(0.0268)	(2.835)
Mergers		Yes	Yes		Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Operator Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,285	6,285	6,285	6,285	6,285	6,285
R-squared	0.551	0.589	0.619	0.637	0.653	0.667
Number of operators	111	111	111	111	111	111

Notes: Robust standard errors are in parenthesis. Symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Revenues - Parallel trends assumption

$$ln(y_{it}) = \alpha + \sum_{j \neq 2006q4-2007q3} \delta_j (G_i * I(t = j)) + \eta_t + \lambda_i + \phi X_{it} + \varepsilon_{it}$$

Figure: Parallel trends assumption - Placebo test - Time relative to the regulation



(a) ARPU in Euros

(b) ARPU in Euros PPP

Tariffs

Tariffs - Data

- Tarifica
  - Mobile plan level: tariffs and plan characteristics (type, minutes, SMS and data allowances, only voice, validity, contract length)
  - Several mobile plans for one mobile operator per country (12, OECD)
- OVUM
  - Herfindahl-Hirschman Index (HHI)
- World Bank
  - Purchasing Power Parities (PPP), exchange rates, GDP, surface, fixed broadband subscriptions, proportion of urban population

$\Rightarrow$ Panel data

  - Timeframe: 2014q1 - 2017q4 (quarterly)
  - Level of observation: country-operator-plan-quarter

Tariffs - Empirical Approach

Hedonic Price Regression - two step approach

1. We estimate the impact of plan characteristics and the interaction between country and quarterly dummy variables on plan tariffs

$$y_{ict} = \alpha + \beta X_{ict} + \delta_{ct} + u_{ict}$$

2. We estimate the impact of the regulation on the quality-adjusted price index for each country using a difference-in-difference approach

$$\delta_{ct} = \gamma + \theta Z_t + \beta G_c + \delta(G_c * RLAH_t) + \eta_t + \varepsilon_{ct}$$

Where

- y_{ict} is the list price of plan i, in country c which was available in quarter-year t
- X is a vector of plan characteristics
- Z is a vector of country-level control variables
- G is an indicator variable denoting the treatment group
- η is a vector of quarter-year fixed effects

Tariffs - Results

Figure: First stage - Quality-adjusted price indexes

Tariffs - Results

Table: Second stage - OLS estimates of the impact of the RLAH phase of EU roaming regulation on tariffs

	Tariff USD			Tariff USD PPP		
	(1)	(2)	(3)	(4)	(5)	(6)
Regulated Countries	-26.68***	-36.11***	-20.34***	-26.92***	-33.61***	-15.63***
	(4.198)	(8.558)	(5.303)	(3.825)	(7.779)	(4.349)
Did RLAH	5.856	7.662	7.487	5.576	4.493	4.121
	(15.95)	(13.74)	(13.76)	(15.18)	(14.18)	(14.41)
HHI		-49.85	-12.56		20.91	51.75
		(38.78)	(36.69)		(42.79)	(39.72)
Fixed Broadband		-0.703*	-0.671		-1.307***	-1.458***
		(0.421)	(0.497)		(0.350)	(0.437)
GDP per capita		0.00131***	0.00143***		0.00175***	0.00196***
		(0.000296)	(0.000301)		(0.000385)	(0.000388)
Population Density		0.104***			0.0971***	
		(0.0337)			(0.0351)	
Urban (% of total population)			-0.258			0.0980
			(0.340)			(0.349)
Constant	143.2***	123.7***	129.0***	133.0***	90.92***	70.26**
	(4.121)	(16.92)	(25.31)	(3.001)	(20.57)	(28.59)
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	192	192	192	192	192	192
R-squared	0.321	0.592	0.574	0.349	0.504	0.485

Notes: Robust standard errors are in parenthesis. Symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Conclusions

Our results suggest that

- The EU roaming regulation has decreased mobile operators' revenues per user
  - in average by 12.6% since 2007 (9.3% when considering PPP)
- There is no evidence of any strategic increase in tariffs by MNOs due to the regulation (no waterbed effect)

Policy Implications

Our results suggest that

- The European Commission has succeeded to avoid unintended increases in domestic tariffs
  - No negative distributional effects (at least some of them)
  - Fair use policy and sustainability derogation are working adequately
- Mobile network operators have absorved the effect of the regulation (decreased revenues)
  - What about profits?
  - What about quality of mobile offers and incentives to invest?

Next Steps

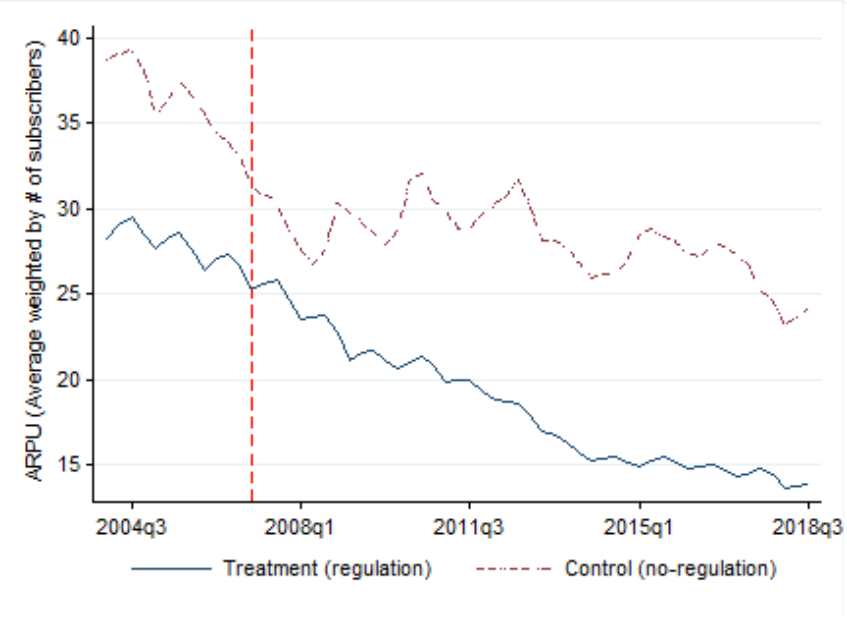
- Refine the analysis of ARPU and Tariffs
- Conduct analysis on tariffs using the FCC mobile broadband data (larger panel of countries and operators, larger period covered, possible to study the total cost of plan)

Thank you

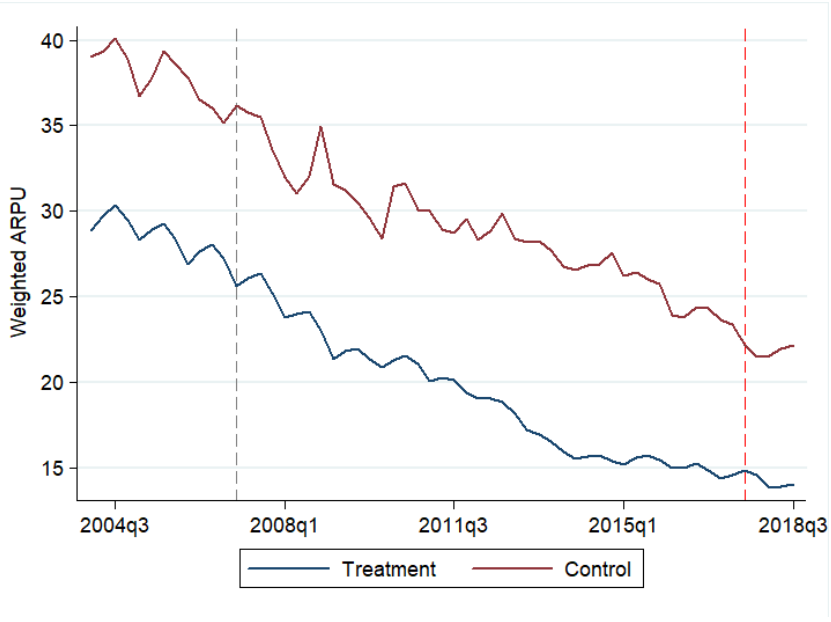
Appendix

Evolution of Revenues (ARPU)

Figure: Evolution of ARPU by group (average weighted by number of subscribers)



(a) ARPU in Euros



(b) ARPU in Euros PPP

Revenues - Data

Table: Analysis of revenues - Number of countries and operators considered (OECD)

	Total	Regulated	Non-regulated
Number of countries	33	23	10
Number of operators	111	76	35

Table: Analysis of revenues - Summary statistics at the operator and country levels

	Obs.	Mean	Std. Dev.	Min	Max
ARPU (Euros)	6,285	22.9	11.6	2.4	68.1
ARPU (Euros PPP)	6,285	23.6	10.4	4.3	110.0
Population (in millions)	1,947	36.2	58.7	1.3	328.2
Population density	1,947	120	109	2.6	411
GDP per capita (Euros)	1,947	27,314.9	15,388.4	4,866.7	79,127.7
GDP per capita (Euros PPP)	1,947	26,480.4	8,876.2	9,193.8	53,413.0
MTR (Euros)	1947	0,05	0,05	0,00	0,30
MTR (Euros PPP)	1947	0,07	0,07	0,00	0,35

- Mergers: 21
- Entries: 13
- 4G commercial roll-out: 22.6/59 quarters with 4G per operator on average

ARPU analysis – comparison of groups

Table: Summary statistics by group at the country level – focus on 2007q3 (quarter before the regulation)

	Group	Mean	Std. Dev.	Min	Max
Population (in millions)	Control	69,9	92,7	4,2	301,0
	Treatment	20,3	24,1	1,3	80,9
Population density	Control	105,1	127,4	2,7	336,6
	Treatment	123,5	100,6	12,2	395,9
GDP per capita PPP ($)	Control	31095,4	12986,0	14000,0	49737,8
	Treatment	32037,4	10156,9	16785,1	55887,1
ARPU in euros	Control	28,1	11,4	9,8	41,9
	Treatment	26,2	9,2	7,2	42,1
ARPU in euros PPP	Control	32,3	9,5	16,9	42,9
	Treatment	27,9	5,7	12,7	36,2
Number of operators per country	Control	3,5	1,0	2,0	5,0
	Treatment	3,3	0,8	2,0	5,0

ARPU analysis including MTR

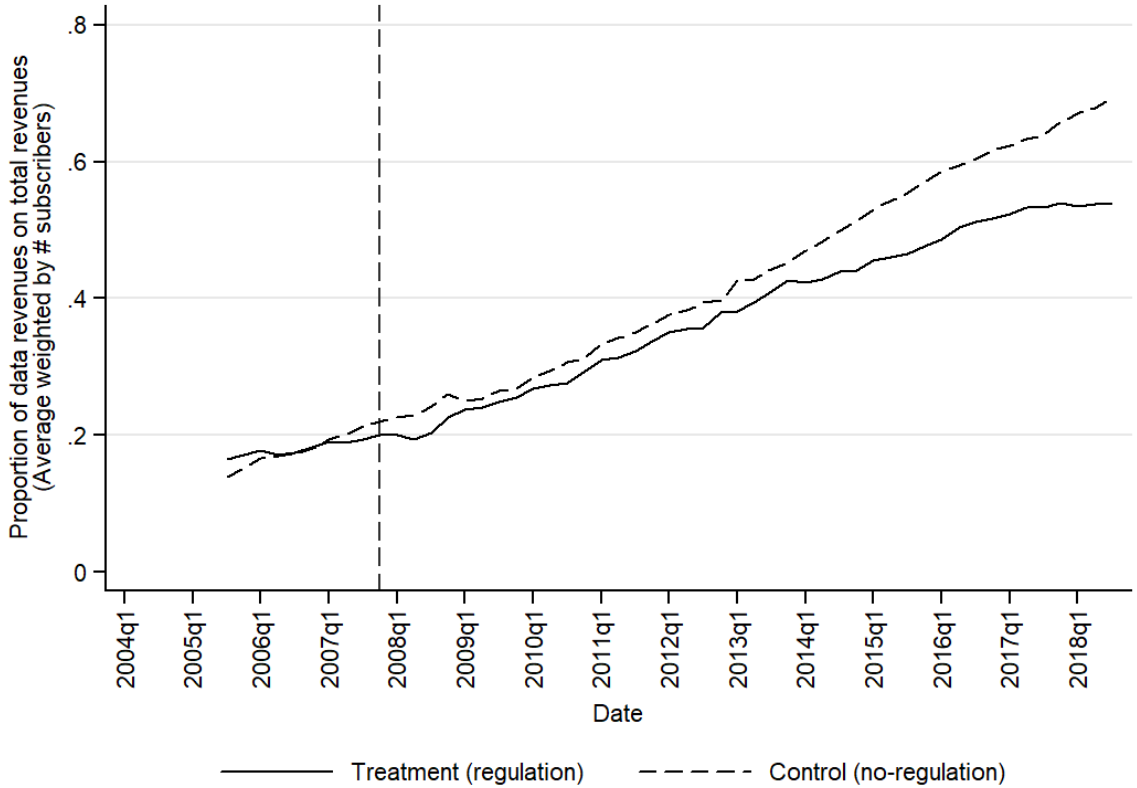
Table: OLS estimates of the impact of the EU roaming regulation on operators' Average Revenues per User including the effect of Mobile Termination Rates

Dep. Variable	Log(ARPU euros)			Log(ARPU euros PPP)		
	(1)	(2)	(3)	(4)	(5)	(6)
Did regu since 2007q4	-0.156***	-0.130**	-0.0956**	-0.0980*	-0.0812	-0.0599
	(0.0516)	(0.0502)	(0.0392)	(0.0526)	(0.0595)	(0.0400)
Log(MTR+1)	2.257***	2.341***	2.185***	1.138***	1.188***	1.849***
	(0.563)	(0.671)	(0.643)	(0.352)	(0.409)	(0.483)
Log(GDP pc PPP)			0.449***			0.656***
			(0.107)			(0.197)
Log(Population Density)			-0.00801			-0.0955
			(0.331)			(0.318)
Entry			-0.0769			-0.113
			(0.0617)			(0.0713)
4G commercial Rollout			-0.0110			-0.0240
			(0.0238)			(0.0228)
Constant	2.990***	2.979***	-1.363	3.262***	3.253***	-2.965
	(0.0744)	(0.0896)	(1.848)	(0.0594)	(0.0690)	(2.528)
Mergers		Yes	Yes		Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Operator Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,285	6,285	6,285	6,285	6,285	6,285
R-squared	0.575	0.610	0.637	0.649	0.663	0.688
Number of idop	111	111	111	111	111	111

Notes: Robust standard errors are in parenthesis. Symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

ARPU analysis including MTR

Figure: Evolution of average data revenue share of MNOs in the OECD by group of regulated and non-regulated countries



Tariffs - Data

Table: Analysis of Tariffs - Summary Statistics - Plan Level

Variable	Obs.	Mean	Std. Dev.	Min	Max
Tariff (USD PPP)	11496	60.7	81.0	0.5	790
Tariff (USD)	11496	52.2	78.6	0.3	790
Prepaid plan	11496	0.3	0.5	0	1
Voice included	11496	0.6	0.5	0	1
Data validity (prepaid)	3394	51.6	82.2	1	365
Credit value included (prepaid)	3394	0.2	0.4	0	1
Contract length (postpaid)	8102	10.1	9.7	1	24
Minutes allowance	8305	154.3	312.1	0	1600
SMS allowance	7079	54.9	186.7	0	1500
Data allowance (in GB)	11467	7.8	15.3	0	100

Table: Analysis of Tariffs - Summary Statistics - Country Level

Variable	Obs.	Mean	Std. Dev.	Min	Max
HHI	192	0.3	0.1	0.3	0.5
Fixed Broadband (subs. per 100 people)	192	29.3	9.2	10.5	43.8
GDP per capita (USD PPP)	192	38,492	10,823	17,253	59,532
GDP per capita (USD)	192	35,162	15,603	8,450	62,328
Population Density	192	99.9	89.7	3.1	272.9
Urban (% of total population)	192	79.3	7.3	60.1	87.5

Evolution of hedonic prices - Tarifica (all)

Figure: Evolution of Quality-Adjusted Price Index by Group