



# Testing the “waterbed” effect in mobile telephony

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6<sup>th</sup> Conference on Applied Infrastructure Research  
Berlin, 6<sup>th</sup> October 2007

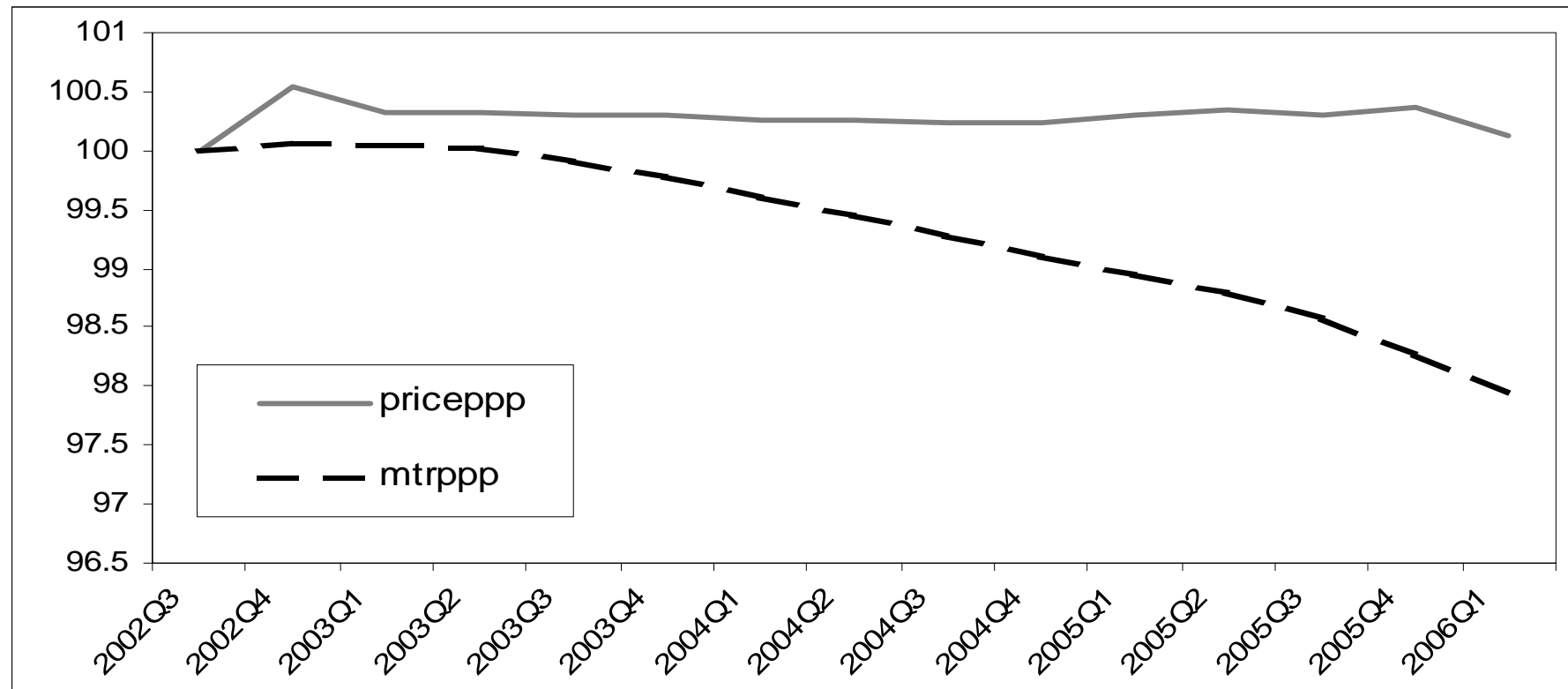
# A “waterbed” effect

- Mobile telephony largely unregulated, with the important exception of **Mobile Termination Rates (MTR)**.
- The “bottleneck” monopoly problem.
- Mobile customers bring a termination “rent”.
- Competition for customers might exhaust this rent.
- Intervention to cut MTR -> can it cause other prices to go up? **The waterbed!**

# Regulation and the waterbed effect

- Most regulators have established the need to intervene in fixed-to-mobile (F2M) calls.
- One of the **EC markets recommended for ex ante regulation**.
- Waterbed is mentioned (since first 1997 MMC investigation), but never assessed too carefully.
- Only anecdotal evidence
  - **Ofcom in UK** (2006, 2007): it exists but is incomplete
  - **CC in New Zealand** (2005): first did not believe it exists, then convinced it exists but not sure about practical relevance

# An illustration



- Italy, medium user
- Evidence of no waterbed?

# A simple model of a waterbed: competition

- Profit:  $\pi = (\underbrace{P}_{\text{bill}} - c)N + \underbrace{TQ_I}_{\text{termination rents}}$
- Imagine there is perfect competition
- Then price is:  $P = c - TQ_I / N = c - \tau$
- The lower the termination rent, the higher the price
- In elasticity terms:  $\varepsilon_W = \frac{\partial P}{\partial T} \frac{T}{P} = \frac{1 + \varepsilon_I}{1/\lambda + \varepsilon_N}$
- This elasticity can be below or above -1 even with a full waterbed effect (assumed here).

# A simple model of a waterbed: monopoly

- Similar problem: change in marginal cost
- The lower the termination rent, the higher the marginal cost and the higher the price
- Difference 1. Effect on profits
- Difference 2. Waterbed at work when market is “growing”, but much less when market is fully covered.

# Empirical strategy

- **Is there a waterbed effect?**
  - MTR down -> retail prices up?
- **Is it “full”?**
  - Sector fully competitive, so just a rebalancing of structure of prices?
  - Or market power, so negative impact on operators' profits?
- **Strategy**
  - Exploit differential regulation between countries and, within countries, between operators

# Data

- MTR from Cullen International
- Teligen (2002-2006):
  - Total bill paid by consumers with a given calling profile (fixed weights)
  - High/medium/low user
  - Pre-paid/post-paid
- Merrill Lynch Global Wireless Matrix (2000-2005):
  - ARPU (already includes incoming!)
  - EBITDA



# Is there a waterbed effect?

- Our analysis is based on the following **instrumental variable** regression models:

$$(6) \quad \ln P_{ujct} = \alpha_{ujc} + \alpha_t + \beta_1 \ln(\text{MTR})_{jct} + \varepsilon_{ujct}$$

$$(6a) \quad \ln \text{EBITDA}_{jct} = \alpha_{jc} + \alpha_t + \beta_1 \ln(\text{MTR})_{jct} + \varepsilon_{jct}$$

- $\text{MTR}_{jct}$  is instrumented using Regulation
- Very good instrument!

# Regulation

- We use different indexes:

$$\text{Regulation}_{jct} = 0/1$$

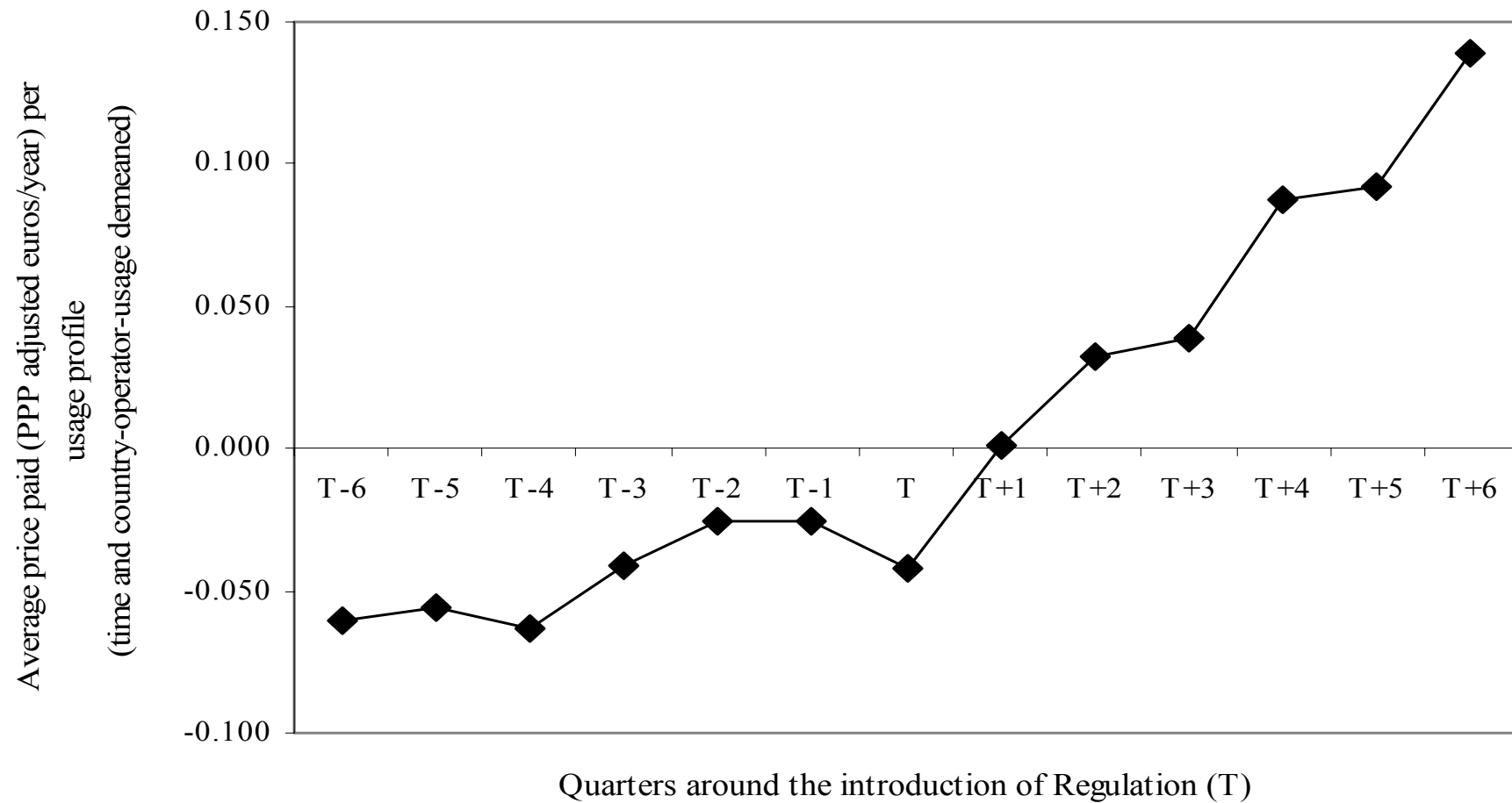
$$\text{MaxMTR index}_{jct} = \begin{cases} 0 & \text{if } MTR_{jct} \text{ is unregulated} \\ \frac{\text{MaxMTR}_{ct} - MTR_{jct}}{MTR_{jct}} & \text{otherwise} \end{cases}$$

$$\text{UnregulatedMTR index}_{jct} = \begin{cases} 0 & \text{if } MTR_{jct} \text{ is unregulated} \\ \frac{\text{UnregulatedMTR}_{ct} - MTR_{jct}}{MTR_{jct}} & \text{otherwise} \end{cases}$$

# Concern

- **Exogeneity** of regulation.
- Theory: all countries should be regulated sooner or later.
- In practice, EC regulations.
- What if countries and operators which have witnessed slower decrease in prices (including F2M prices) than comparable countries are more likely candidates for regulation?

# Average Price around the introduction of Regulation



# WATERBED EFFECT THROUGH MTR

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	IV	IV	IV	IV	IV	IV
Dependent variable	$\ln P_{ujct}$	$\ln P_{ujct}$	$\ln P_{ujct}$	$\ln EBITDA_{jct}$	$\ln EBITDA_{jct}$	$\ln EBITDA_{jct}$
$\ln(MTR)_{jct}$	-1.207*** (0.411)			1.127* (0.603)		
MaxMTR index <sub>jct</sub>		-0.938*** (0.278)			0.070 (0.392)	
UnregulatedMTR index <sub>jct</sub>			-0.334** (0.133)			0.620 (0.862)
1 <sup>st</sup> Stage Coef.	-0.110*** (0.024)	-0.310*** (0.035)	-0.382*** (0.028)	-0.111*** (0.037)	-0.335*** (0.051)	-0.239** (0.098)
1 <sup>st</sup> Stage R <sup>2</sup>	0.044	0.127	0.523	0.045	0.112	0.137
1 <sup>st</sup> Stage F-test	21.83*** [0.000]	78.85*** [0.000]	188.24*** [0.000]	8.90*** [0.004]	43.88*** [0.000]	5.90** [0.028]
Observations	1734	1734	450	1135	1135	319
Clusters	150	150	36	67	67	16

# WATERBED EFFECT THROUGH MTR (Regional-Time Controls)

	(1)	(2)	(3)	(4)
Estimation method	IV	IV	IV	IV
Dependent variable	$\ln P_{ujct}$	$\ln P_{ujct}$	$\ln \text{EBITDA}_{jct}$	$\ln \text{EBITDA}_{jct}$
$\ln(\text{MTR})_{jct}$	-1.529*** (0.496)		1.415* (0.757)	
MaxMTR index <sub>jct</sub>		-1.076*** (0.283)		0.187 (0.473)
1 <sup>st</sup> Stage Coef.	-0.100*** (0.023)	-0.294*** (0.032)	-0.098** (0.038)	-0.288*** (0.052)
1 <sup>st</sup> Stage R <sup>2</sup>	0.038	0.123	0.040	0.097
1 <sup>st</sup> Stage F-test	18.15*** [0.000]	85.18*** [0.000]	6.47** [0.013]	30.43*** [0.000]
Observations	1734	1734	1135	1135
Clusters	150	150	67	67

# Results

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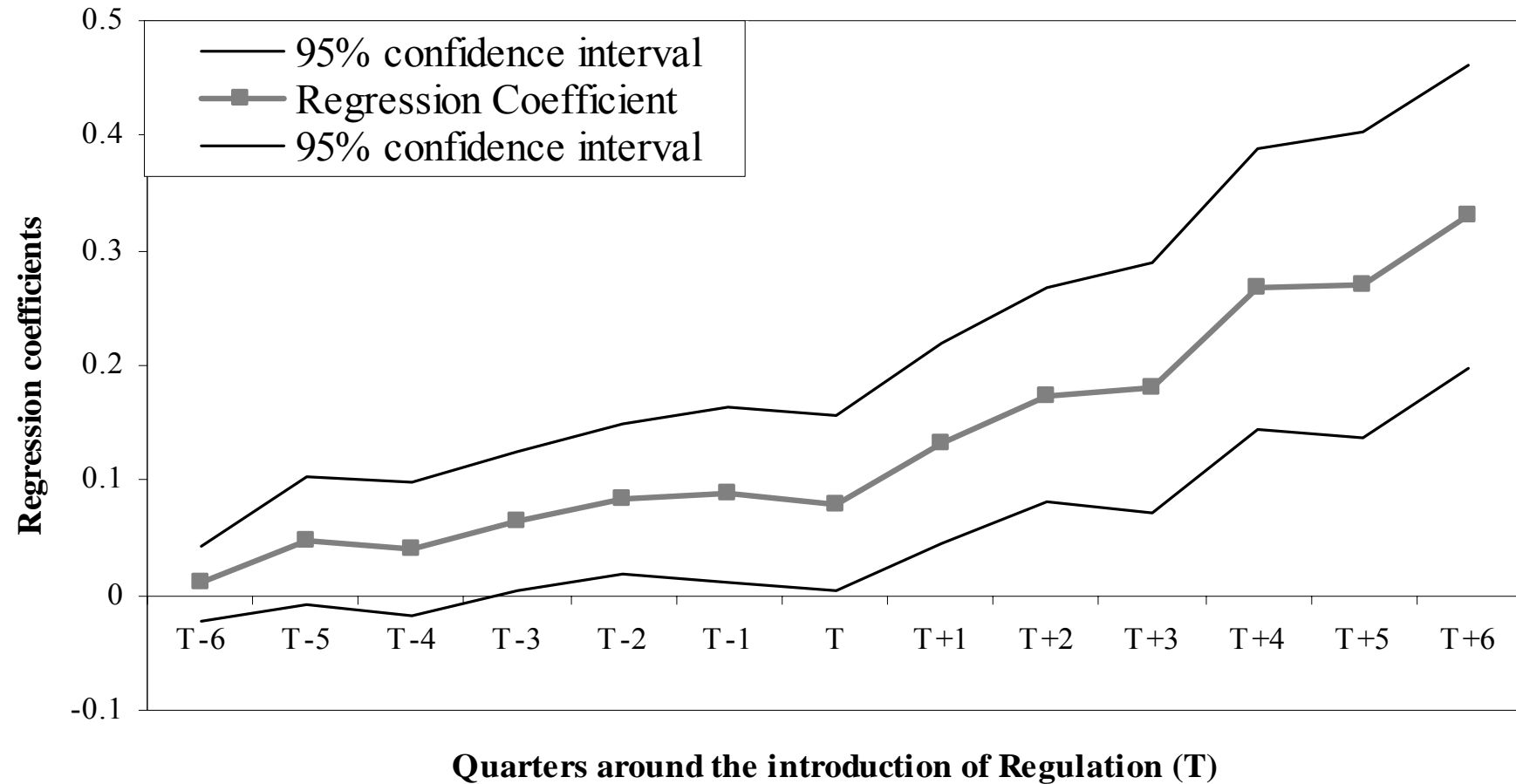
- The waterbed effect exists.
- Teligen (prices).
- ML (profits – also ARPU). Negative impact on (accounting) profits: there is not “neutrality”.

# Additional results

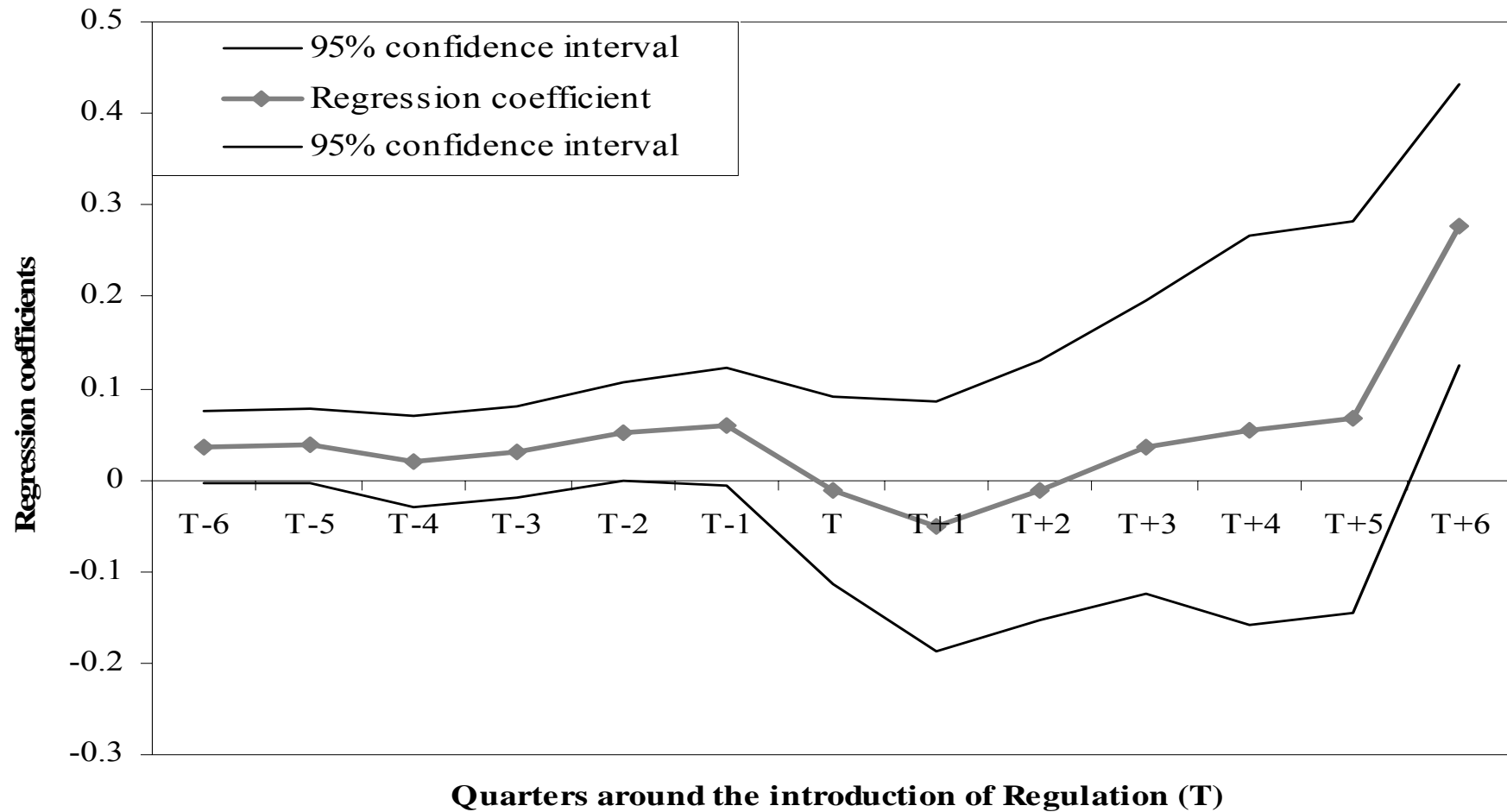
- **Timing** and impact of regulation
- Differential impact on **pre- and post-paid** customers:
  - Applies to post-paid, not to pre-paid (Receive less calls?  
Expectation of receiving less future incoming revenues?)
- Impact of **competition** and subscriber penetration



# The Evolution of the Waterbed Effect



# The Evolution of the Waterbed Effect (Pre-Paid)



# COMPETITION AND WATERBED EFFECT

	(1)	(2)	(4)	(5)
Estimation method	IV	IV	GMM	GMM
Dependent variable	$\ln P_{ujct}$	$\ln P_{ujct}$	$\ln P_{ujct}$	$\ln P_{ujct}$
$\ln(\text{MTR})_{jct}$	-1.580** (0.587)	-1.282** (0.525)	-0.775*** (0.235)	-0.585*** (0.223)
$\ln(\text{competitors})_{ct}$		-0.289* (0.173)	-0.522*** (0.178)	-0.344** (0.173)
$\ln(\text{mkt penetration})_{ct}$		-0.768 (0.483)	-1.785*** (0.563)	-3.228*** (0.840)
$\ln(\text{MTR})_{jct} \times \ln(\text{competitors})_{ct}$			0.168* (0.087)	0.098 (0.083)
$\ln(\text{MTR})_{jct} \times \ln(\text{mkt penetration})_{ct}$			0.168 (0.141)	1.422*** (0.364)
$\ln(\text{competitors})_{ct} \times \ln(\text{mkt penetration})_{ct}$			0.962** (0.441)	2.346*** (0.557)
$\ln(\text{MTR})_{jct} \times \ln(\text{competitors})_{ct} \times \ln(\text{mkt penetration})_{ct}$				-0.895*** (0.248)
$\Delta P / \Delta \text{competitors}$		-1.282	-0.345	-0.263
$\Delta P / \Delta \text{MTR}$		-0.289	-0.583	-0.498
$\Delta P / \Delta \text{mkt penetration}$		-0.768	-0.256	0.269
Observations	1371	1371	1371	1371
Clusters	141	141	141	141
Sargan-Hansen test of overidentifying restrictions	-	-	4.418 [0.220]	6.071 [0.108]

# Caveat

- No data on handset subsidies (though should not affect results with EBITDA).
- No country-time dummies (though we did regional-time joint effects).
- Results may be biased if a country, which is regulated with low MTR is concentrated and compared with another country not regulated but competitive.

# Conclusions and implications

- **Strong evidence of a “waterbed” effect.** Strong but not “full”.
- This has **antitrust** implications: market for subscription and outgoing interlinked with market for incoming calls.
- It also has implications in terms of **remedies** (welfare maximising regulated MTR) if elastic subscription & network externalities.
- Concentrate more efforts on understanding behaviour of **marginal users**.