Estimating call externalities in mobile telephony in Poland

University of Warsaw
Faculty of Economic Sciences

Maciej Sobolewski, Mikołaj Czajkowski
University of Warsaw

Presentation on 2016 Warsaw International Economic Meeting, 29/06/2016

Agenda

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Motivation

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- Two types of economic externalities in mobile telecommunications
  - Network externalities induced by termination based discrimination
  - Call externalities induced by „calling party pays" interconnection regime
- Network operators strategically adjust pricing to take advantage of both
- The outcomes are detrimental for social welfare
  - Too much on-net and too little off-net connectivity
- …and dynamic competition
  - Too little entry on a market
  - Strategic disadvantage of late entrant (market share stealing effect, access deficit)

Empirical evidence: Excessive off-net calls asymmetry between 3MNO and P4 (Play)

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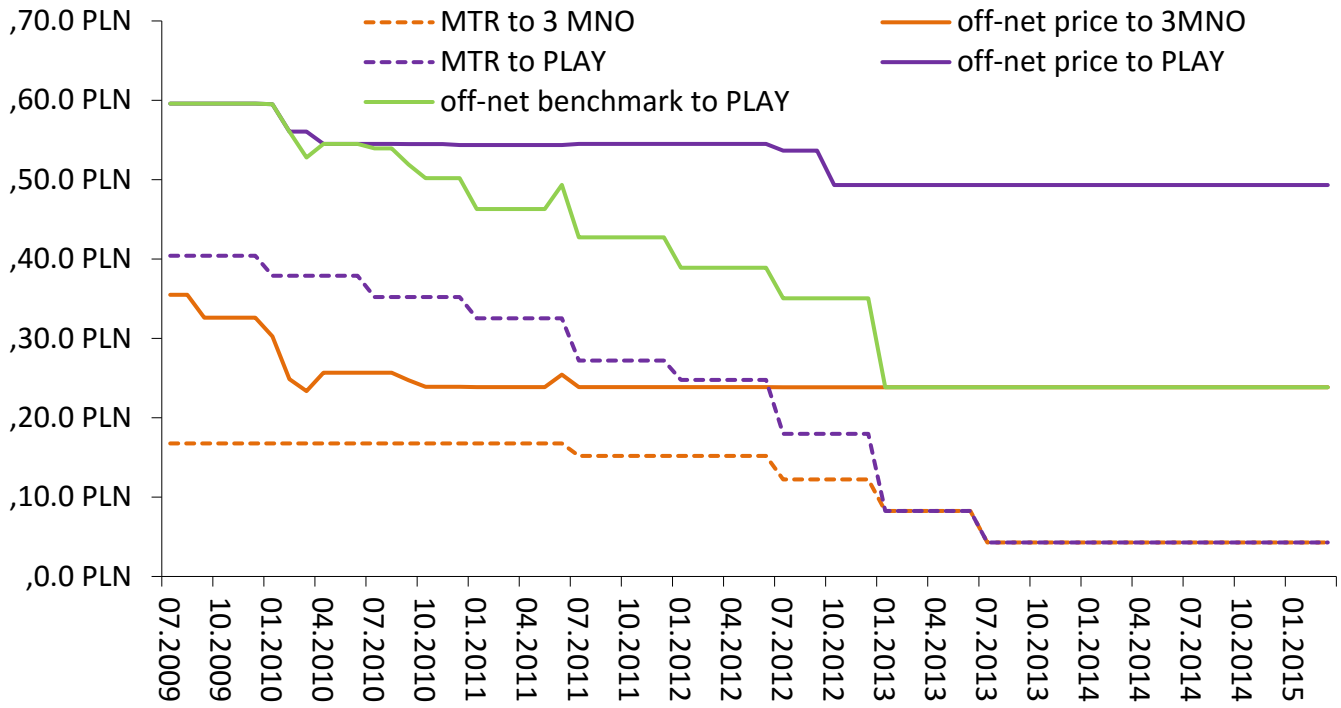
- According to a common markup benchmark, prices for off-net calls to Play (green line) should have been on average 29% lower throughout the period 04.2010-03.2015 compared to actual levels of off-net prices set by incumbents in that period (violet line).



- source: Market monitoring provided by Audytel SA

Objectives

- To identify and quantify receiver benefits at individual level
- To assess the impact of call externalities on the market shares of mobile operators in Poland
  - Policy exercise with two counterfactual scenarios
    - Common markup benchmark on incoming calls under asymmetric MTR
    - Equal off-net prices under symmetric MTR

Literature

- Network effects extensively studied in economics since (Katz and Shapiro, 1985).
- In telecommunications:
  - Are induced by termination based discrimination (Laffont et al., 1998)
  - Are not homogenous across all members of the network (Maicas and Sese, 2011)
  - Are localized among family and friends (Corrocher and Zirulia, 2009)
  - Have diminishing marginal value and tend to exist even without on-net price discount (Czajkowski and Sobolewski, 2011)
  - Drive consumer choices (Maicas et al. 2009b; Sobolewski and Czajkowski 2012)
  - Impact network competition by creating lock-in (Doganoglu and Grzybowski 2007 ; Grajek 2010)

Literature

- Call externalities studied in economics since Jeon et al. (2004)
  - Building on canonical model of duopoly network competition from Laffont et al., (1998), in the presence of receiver benefits networks will strategically increase off-net prices to reduce the volume of outgoing calls and lower attractiveness of rival network (Berger 2005)
  - The greater the receiver benefits the greater the gap between off-net and on-net calls (Jeon et al. 2004)
  - Strategic overpricing effect increases with the market share and will have a detrimental impact on smaller networks in oligopoly causing access deficit and connectivity breakdown (Armstrong and Wright 2009 ; Hoernig, 2007; Calzada and Valletti 2008)
  - Weak empirical evidence supporting call externalities is provided in (Harbord and Pagnozzi 2010)
  - There are no rigorous empirical studies related to identification and estimation of call externalities. Hence, our paper offers a clear value added

Data and Methodology

- We apply discrete choice experiment on two large representative samples of prepaid (N=1001) and postpaid subscribers (1029).
- We use Bayesian efficient design with 3 blocks. Each respondent had 12 choice situations with four alternatives; each described by 6 attributes.

Which of the following mobile phone operators' offers would you consider the best for yourself?

Operator	ORANGE	T-MOBILE	PLUS	PLAY
On-net price per minute (PLN)	0.2	0.1	0.3	0.2
Off-net price per minute (PLN)	0.2	0.5	0.5	0.2
Price of incoming off-net call, per minute (PLN)	0.3	0.3	0.3	0.3
'Family and Friends' in the same network	25%	25%	75%	75%
'Others' in the same network	50%	50%	25%	75%
Your choice	□	□	□	□

Call externality

Network ext.

Data and Methodology

- We apply random utility framework (McFadden 1974)
- $U_{i,s,r} = \beta_{SQ}SQ + \beta_{ORA}ORA + \beta_{TMB}TMB + \beta_{PLU}PLU + \beta_{PLA}PLA + \beta_{P\_ON}P_{ON} + \beta_{P\_OFF}P_{OFF} + \beta_{P\_INCOFF}P_{INCOFF} + \beta_{FF}FF + \beta_{OTH}OTH + \varepsilon_{i,s,r}$
- We use mixed logit to model choice obtained via survey.
  - Consumer *i* has specified, albeit non-observable, parameters of the utility function which follow a priori specified distributions in a population $\boldsymbol{\beta}_i \sim f\ (\boldsymbol{b}, \boldsymbol{\Sigma})$, where $\boldsymbol{b}$ is the vector of the mean values of parameters and $\boldsymbol{\Sigma}$ is their variance-covariance matrix. Unconditional choice probabilities P_{ijt} need to simulated, then estimators of $\boldsymbol{b}, \boldsymbol{\Sigma}$ can be obtained from the following log-likelihc

$$\log L = \sum_{i=1}^{N} \ln \left(\int_{\boldsymbol{\beta}} \prod_{t=1}^{T} P_{ijt}(\boldsymbol{\beta}) f\left(\boldsymbol{\beta} \middle| \mathbf{b}, \boldsymbol{\Sigma}\right) d\boldsymbol{\beta} \right)$$

Results (postpaid)

- SQ and prices are log-normally distributed. Parameters for underlying normal distributions are provided.
- All three:
  - **Switching costs**
  - **Call externalities**
  - **Network effects**
- signifficant

9 *Table 5. Estimates of utility function parameters for postpaid subscribers.*

	MNL	MXL_d		GMXL_d		MXL	
	coefficient (s.e.)	Mean (s.e.)	St. Dev. (s.e.)	Mean (s.e.)	St. Dev. (s.e.)	Mean (s.e.)	St. Dev. (s.e.)
SQ operator (SQ)	1,3207*** (0,0204)	0,1088 (0,0904)	1,8844*** (0,1284)	0,2518*** (0,0927)	1,9215*** (0,1420)	0,2149*** (0,0838)	1,5661*** (0,1065)
Orange vs. Play	-0,2996*** (0,0279)	-0,5445*** (0,0639)	1,0605*** (0,0700)	-0,6113*** (0,0738)	1,1878*** (0,0816)	-0,2746*** (0,1123)	1,5055*** (0,0891)
T-Mobile vs. Play	-0,2780*** (0,0285)	-0,6572*** (0,0630)	1,0558*** (0,0671)	-0,7591*** (0,0738)	1,1840*** (0,0763)	-0,4320*** (0,1107)	1,5203*** (0,0897)
Plus vs. Play	-0,2303*** (0,0281)	-0,5328*** (0,0602)	0,9819*** (0,0691)	-0,6288*** (0,0708)	1,0889*** (0,0815)	-0,2592*** (0,1085)	1,4262*** (0,0865)
On-net price (P_ON)	6,6729*** (0,1481)	2,2407*** (0,0436)	0,8637*** (0,0411)	2,4322*** (0,0478)	0,7994*** (0,0417)	2,1814*** (0,0577)	1,1412*** (0,0540)
Off-net price (P_OFF)	4,8642*** (0,1468)	1,8512*** (0,0574)	0,9957*** (0,0596)	2,0678*** (0,0583)	0,8980*** (0,0485)	1,5915*** (0,0832)	1,4283*** (0,0675)
Incoming off-net price (P_INCOFF)	1,6027*** (0,1400)	0,6950*** (0,1212)	0,8834*** (0,0955)	0,9709*** (0,1113)	0,7920*** (0,0856)	0,5138*** (0,1691)	1,4786*** (0,1071)
Family & Friends (FF)	0,4470*** (0,0544)	1,0536*** (0,1546)	3,7206*** (0,1590)	1,2365*** (0,1826)	4,2326*** (0,2003)	0,9718*** (0,2023)	4,1352*** (0,1993)
Others (OTH)	-0,0844 (0,0526)	-0,1489 (0,1077)	2,0590*** (0,1253)	-0,1712 (0,1254)	2,3391*** (0,1506)	-0,0091 (0,1476)	2,2718*** (0,1506)
Tau				3.1675*** (0.2708)			
Model characteristics							
Log-likelihood (constants)	-17011,1598	-17011,1598		-17011,1598		-17011,1598	
Log-likelihood	-13449,5980	-10487,7399		-10459,2453		-10082,3011	
McFadden Pseuro-R^2	0,2094	0,3835		0,3852		0,4073	
Ben-Akiva Lerman Pseuro-R^2	0,3541	0,4694		0,4701		0,4830	
AIC/n	2,1799	1,7016		1,6972		1,6418	
n (# observations)	12348	12348		12348		12348	
k (# parameters)	9	18		19		54	

10 Source: Own calculations. ***, **, * Significance at 1%, 5%, 10% level

Policy exercise

- SC1: reduced off-net assymetry; SC2: full symmetry

difference in choice probability dP (scenario 1- baseline): Postpaid

		MNL	MXL_d	GMXL_d	MXL
orange	dP (s.e.)	0,71%***(0,11%)	0,61%***(0,09%)	0,89%***(0,12%)	0,82%***(0,13%)
	95% c.i.	(0,49%;0,93%)	(0,43%;0,81%)	(0,67%;1,15%)	(0,59%;1,11%)
tmobile	dP (s.e.)	0,77%***(0,08%)	0,55%***(0,06%)	0,67%***(0,07%)	0,58%***(0,06%)
	95% c.i.	(0,61%;0,93%)	(0,43%;0,68%)	(0,55%;0,82%)	(0,47%;0,71%)
plus	dP (s.e.)	1,03%***(0,13%)	0,87%***(0,11%)	1,25%***(0,15%)	1,43%***(0,17%)
	95% c.i.	(0,78%;1,28%)	(0,66%;1,1%)	(0,98%;1,56%)	(1,12%;1,8%)
play	dP (s.e.)	-2,51%***(0,32%)	-2,02%***(0,26%)	-2,82%***(0,33%)	-2,83%***(0,32%)
	95% c.i.	(-3,13%;-1,88%)	(-2,57%;-1,53%)	(-3,5%;-2,2%)	(-3,51%;-2,26%)

difference in choice probability dP (scenario 2 - baseline): Postpaid

		MNL	MXL_d	GMXL_d	MXL
orange	dP (s.e.)	2,36%***(0,32%)	2,15%***(0,28%)	3,16%***(0,39%)	2,77%***(0,38%)
	95% c.i.	(1,74%;2,97%)	(1,65%;2,74%)	(2,44%;3,97%)	(2,12%;3,61%)
tmobile	dP (s.e.)	1,81%***(0,24%)	1,49%***(0,18%)	1,97%***(0,23%)	1,65%***(0,2%)
	95% c.i.	(1,35%;2,28%)	(1,15%;1,88%)	(1,54%;2,44%)	(1,29%;2,08%)
plus	dP (s.e.)	2,88%***(0,37%)	2,64%***(0,33%)	3,88%***(0,47%)	4,1%***(0,49%)
	95% c.i.	(2,16%;3,6%)	(2,03%;3,33%)	(3,03%;4,85%)	(3,23%;5,14%)
play	dP (s.e.)	-7,05%***(0,92%)	-6,28%***(0,77%)	-9%***(1,06%)	-8,53%***(0,9%)
	95% c.i.	(-8,84%;-5,24%)	(-7,91%;-4,87%)	(-11,18%;-7,04%)	(-10,48%;-6,93%)

Source: Own calculations.

Conclusions

- Call externalities are among important drivers of mobile operator choice for both prepaid and postpaid subscribers, next to price effects, switching costs and network effects.
- Consumers are discouraged to subscribe to networks for which incoming calls are higher
- Excessive asymmetry in off-net calls between 3 incumbent MNO and new entrant (P4) had detrimental impact on market share of P4.
- In reduced asymmetry scenario, under a common markup benchmark Play would gain 2.8 p.p in market share in postpaid segment
- Under full symmetry Play would gain 8.5 p.p
- Regardless of the strategic impact of incumbents, asymmetric regulation of MTR is also costly for its beneficiaries. This has largely been overlooked in practical considerations.

Thank you!

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The paper can be downloaded from czaj.org

Maciej.sobolewski@uw.edu.pl