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Fixed Internet Access Regulatory Framework and Its Influence on Firm's Strategic Decision Making

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Abstract

Regulation undoubtedly plays a crucial role in the telecom industry. It is especially evident in the Internet fixed access regulation where regulatory authorities and telecom operators face with complex technological solutions as well as sophisticated costing methodologies in order to satisfy their own and customers' needs. Regulation is explained under Institutional theory as a formal way of analyzing institutional context. The purpose of this paper is to present formal ways of regulatory regime expressed as Local Loop Unbundling (LLU) price and countries' formal framework showed as Worldwide Government Indicators (WGI) which are compared with companies' decisions regarding to technological choices and Incumbent's performance. Different costing methodologies used in defining wholesale and retail prices of regulated products will also be described. Results of the first part of empirical analysis based on companies from 13 European countries from period 2010-2014 show that LLU price has significant role in strategical decision making whether to invest in new/other technologies or to use existing incumbent's infrastructure based on copper network. The higher the price of LLU, the lower the percentage of customer base on incumbent's cooper network. In some European countries it is evident that incumbent has a significant power on the market, even though we are witnesses of imposed regulatory regime for a many years. One of the reasons for this can be inadequate regulatory quality and situation in the country as a whole. The second part of empirical analysis investigates influence of WGI on incumbent's market share.

Keywords: Fixed Internet, Institutional theory, Regulation, Telecom industry

Track: *Entrepreneurship*

Word count: 5.558

1. Introduction

Until 20-30 years ago telecom companies were organized as state monopolies. Lagging behind technological innovation and state inefficiency, they are faced with privatization process and competitive restructuring (Armstrong *et al.* 1994; Armstrong and Sappington, 2006; Kessides 2004; Newberry 1999). Achieving liberalization is very complex process which is influenced by technology features, firm behavior and regulatory incentives (Armstrong and Sappington 2006). Fixed Broadband communications are an interesting field for empirical research due to regulatory and technological features that differentiate them from mobile telecommunication industry. Even regulatory reform was much less successful in fixed than in mobile communications which can be seen in operator's market concentration (Gruber and Koutroumpis, 2013).

Technology diffusion is topic covered by scholars from different management fields, such as information technology, technological innovation, organizational theory and marketing, where it is highlighted as being among key drivers of sustained competitive advantage (Greve, 2009; Distaso *et al.*, 2006; Denni and Gruber, 2007; Bouckaert *et al.*, 2010; Gruber and Koutroumpis, 2013).

Results of regulatory reforms caused rapid development of competition. Telecommunications are known as one of the sectors where regulatory reform gives very positive results, especially in the part of service pricing (Winston, 1993).

Fixed broadband is characterized by inter-platform competition and intra-platform competition (Gruber and Koutroumpis, 2013). In Croatia, Hrvatski telekom (T-HT) is an incumbent and the only regulated company in fixed broadband. T-HT is obliged to offer their own infrastructure based on copper pair cable network to other operators in the market under conditions which are approved by regulatory agency HAKOM. Operators Optima and Iskon build up their customer base exclusively on T-HT infrastructure – they compete on incumbent's infrastructure which is called intra-platform competition.

Challenger Vipnet has its own infrastructure based on coax cable and fibre optics – compete with others on inter-platform basis. Infrastructure based on copper cable is leasing from T-HT where finds it profitable - from perspective of structure and strategy that tend to produce acceptable rents (above normal rates of return) (Oliver, 1997; Peng, 1993) . In this way Vipnet wants to differentiate from those of competitors. But differentiation strategy is often risky, difficult and might be the only way to achieve higher profits and become independent regarding to technology choices. Some countries allow other operators to earn only certain margin over existing incumbent's products and do not allow them to differentiate and compete (Gruber and Koutroumpis, 2013). That automatically foster competition at different levels grounded on network duplication which produce costs and a direct effect on the policy and economic agenda (Gruber and Koutroumpis, 2013).

This paper provides contribution in two parts. First, it extends the theory of technology transmission and diffusion across firms under regulatory regime. Second, it demonstrates impact of government (in)efficiency to open the market and set up competitive conditions.

2. Literature review and research design

Decisions done by companies are constrained by technological, informational and institutional constructs. Institutional construct can be viewed from sociological (norms, customs and habits) and economists point of view (rules, laws and regulations) (DiMaggio & Powell, 1983; North, 1990, Scott, 1995). The fact that institutions matter is as old as the study of economics. Institution based view put the institutions 'in the front' of firm analysis (Peng, 2002). This theory is answer to dominant theory of '*laissez faire*'. Institutions are rules of the game made by formal and informal rules that present legitimate behavior (North, 1990). The basic premise of institutional theory is that firms become homogeneous in their structures and activities trying to conform to predominant social internal and external influences, norms and traditions (Oliver, 1997). External factors are sources of conformity or isomorphism exerted on firms that make them homogenize in certain industry (DiMaggio and Powell, 1983). Successful firms become those that achieve legitimacy by conforming to social pressures (Oliver, 1997).

Firm's institutional context is made of internal culture as well as influences from the state, society and relations among firms that define socially acceptable behavior (Oliver, 1997).

DiMaggio and Powell (1983) identified three types of institutional isomorphism: coercive (direct and indirect impact of government, regulatory agencies and cultural expectations), normative (customs, norms) and mimetic (resulting from standard response to uncertainty). Scott (1995) identifies also three types of isomorphism: regulatory, normative and cognitive. C.Oliver (1997) pointed out that institutional context defines firm behavior at individual, firm and inter-firm level. At the individual level it is viewed through decision-maker's values and

norms, at firm level organizational politics and culture and at inter-firm level public and regulatory pressures and industry norms.

She (Oliver, 1997) defines regulatory pressure as one of the sources of firm homogeneity (among strategic alliances, human capital transfers, social and professional relations and competency blueprints). Regulation provide homogeneity among firms by prescribing resource standards and ways of deploying certain resources.

Next sections will cover regulatory framework in fixed broadband access and strategies that firms undertake in order to comply to industry norms and regulatory requirements and achieve sustained competitive advantage.

2.1. Regulatory agencies and Access regulation

Independent regulatory agencies are established by policy makers in order to correct failures on the market. Agencies should be independent and accountable (Maggetti *et al.* 2015, Armstrong and Sappington, 2006). Independence means that they should ensure long-term predictability of public regulation (crucial hint for market players to decide whether to invest or not) and produce sector specific expertise (economic, legal and technical knowledge) (Maggetti *et al.* 2015). Accountability means the existence of an external inspection to account for one's action (with hearings by parliamentary committees, information exchange between agency, the political trust, peer agencies and the stakeholders, etc.) (Maggetti *et al.* 2015).

Regulatory agencies advocate a cost-oriented approach to determine access charge for network operators. Fixed telecom segment is known as sector where are applied various access prices regimes and measures to enter the market – unbundling policies (Dkhil, 2015).

Which one to use is up to objectives of the institutional context (which takes into account circumstances in the market and strategic decisions on the government/EU level). This section will shortly list methodologies which are used in order to show the complexity of the process behind every regulated service price and importance of the regulatory agencies.

Even costing methodologies find their place in microeconomics, methodologies and questions which arise while deciding which costs to use and how to incorporate them into unit cost calculation will be shortly listed below. They include topics of future demand, technological capacity and geographical coverage which are quite unforeseen in the future and which need to be addressed by regulators and operators while determining costs of services. It impacts operator's strategic decision making.

Cost can be viewed from Top-down and Bottom-up basis (it is desirable to run both of them to ensure robust results because Top-down model is taking actual cost from book keeping and is not taking into account inefficiency while Bottom-up model is an approach from efficient operator on the market).

Commonly used costing methodologies: Fully Allocated Cost (can be based on Historical Costs and Current costs), Long Run Incremental Cost and Long Run Incremental Cost+.

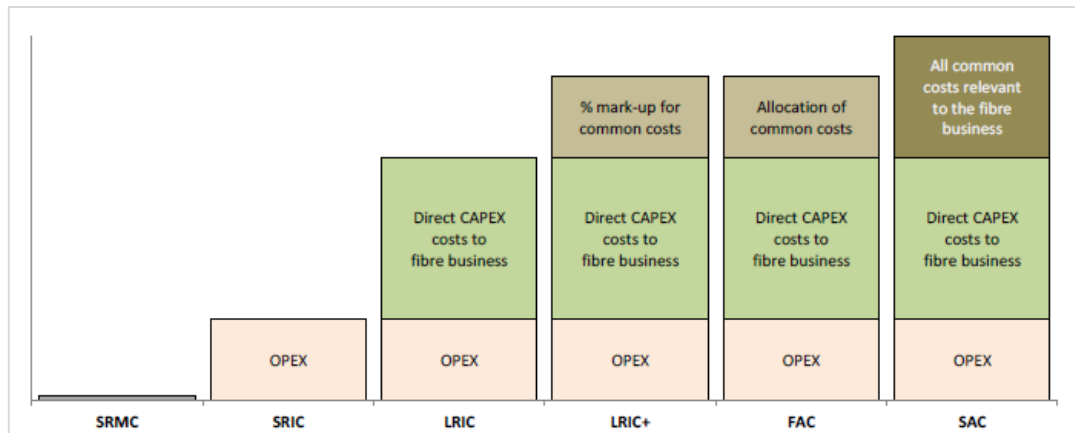


Figure 1: Costing methodologies in access regulation

Source: CRA

The next picture shortly shows all the questions which arise during the cost allocation.

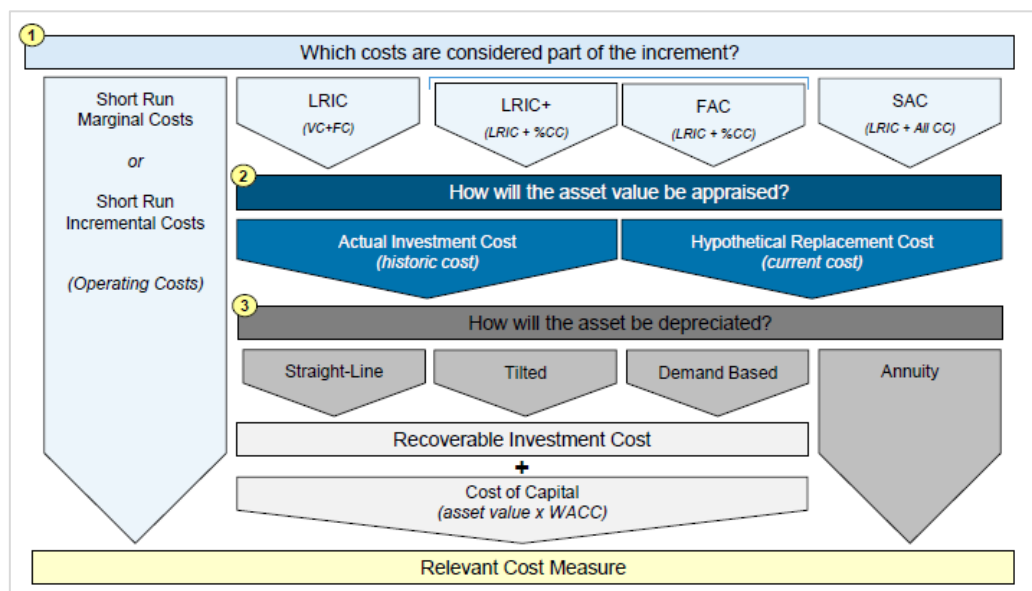


Figure 2: Arising questions during the cost allocation

Source: CRA

All of these questions will affect cost recovery profile of incumbent and entrants which can be done by profile of demand or profile of replacement costs (this is especially important when investing in new technologies) which in the end have impact on access price (CRA, 2011).

Regulator has to prioritize their objectives during the selection of costing methodology - whether to spur new investments or build/buy signals to the entrants. Regulatory decisions can exacerbate or mitigate business risk (CRA, 2011).

There are two ways to enter incumbent's market: Carrier selection (entrant leases line from incumbent and doesn't have any investments) and unbundling access (entrants leases line from incumbent but for some services there are required some investments) (Dkhil, 2015).

There are distinguished four main types of unbundling: Full Local Loop Unbundling (LLU), Subloop Unbundling, Line sharing and Bitstream.

With LLU entrants lease entire cooper loop by incumbent by which can offer different services to end customers (voice and Internet). Incumbent is responsible for line maintenance (OECD, 2003).

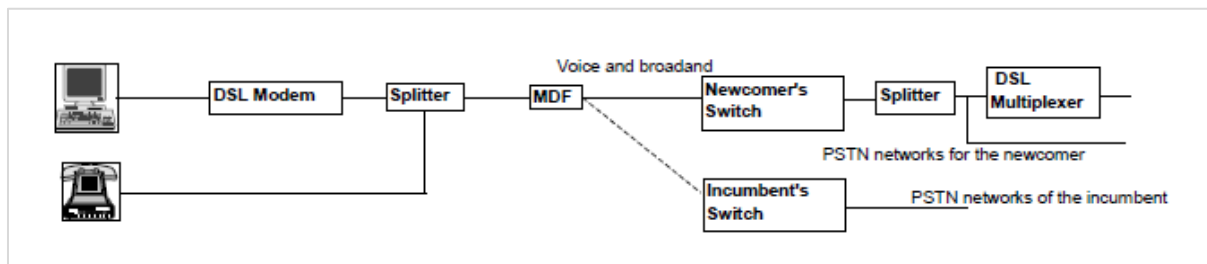


Figure 3: Realisation of Full unbundling access

Source: OECD, 2003

By line sharing entrants provide broadband Internet while incumbent offers voice service to the same customer.

Using Bitstream, entrants do not have to invest in incumbent's technology in order to acquire broadband Internet customer.

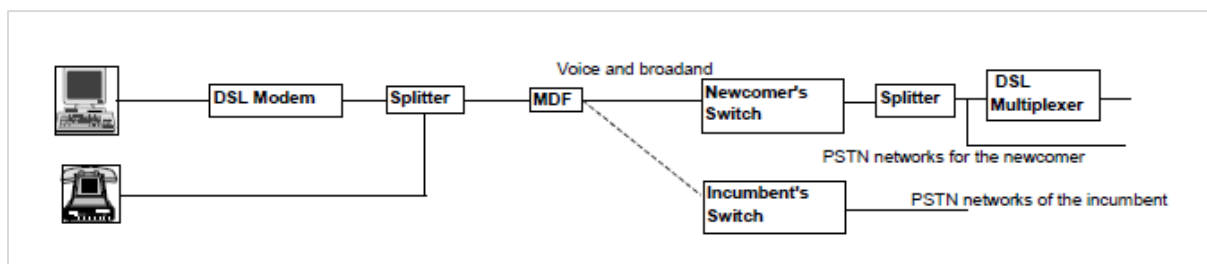


Figure 4: Realization of Bitstream access

Source: OECD, 2003

2.2. Research design

The most commonly used technological solutions in fixed broadband access are access networks using cooper pair cable and coaxial cable. Both of them are used by operators for years and are under significant technological upgrades in order to meet customers' needs. Quite new solution is based on fiber optics network which is popular and many operators are going that way.

As mentioned above, competition among operators is taking place on intra-platform and inter-platform basis.

Intra-platform competition is characterized by two main access options: Local Loop Unbundling (LLU) and retail access - Bitstream (Gruber and Koutroumpis, 2013). The first one is simply connecting (physically) incumbent's line with operators' installed equipment in the incumbent's local exchange and connects the subscriber, while the second one is simple resale of incumbent's service. With LLU operators (entrants) have flexibility to launch different services (a way to differentiate yourself from incumbent), while it is not possible

with simple resale. Incumbent has strong competitive advantage with resale in part of managing costs of lines, hence, competition among operators is centered on price (Bonardi et.al., 2009; Gruber and Koutroumpis, 2013). LLU is widely presented as the best practice how to promote competition in telecommunications, especially to promote the development of Internet usage (Bonardi et. al. 2009).

Inter-platform competition is based on many other platforms which operators are using in order to gain competitive advantage and differentiate themselves from incumbent. Frequently used technologies are based on coax cable and fibre optics.

Scholars mostly focused on investigating how technological solutions impact broadband development and how regulatory decisions have influence on technological investments. Grosso (2006) finds that broadband diffusion is increased by competition, income and unbundling. Garcia-Murillo (2005) finds that broadband deployment is function of unbundling incumbent's infrastructure for middle-income countries, but not for their high income counterparts. Distaso *et al.* (2006) based on 14 European countries and from period 2000-2004 find that competition in DSL market doesn't play significant role in broadband uptake, while inter-platform competition triggers broadband diffusion and lower unbundling prices have positive effect on broadband uptake. Bouckaert *et al.* (2010) find on sample of 19 OECD countries that both inter-platform and intra-platform competition have positive effects on broadband deployment.

Danni and Gruber (2007) find that both platform competition options have positive effect on broadband adoption in US market. Intra-platform has very positive effect in the beginning and inter-platform competition has longer lasting effect on broadband diffusion. Based on analysis of 165 countries and 11 years period, Gruber and Koutroumpis (2013) find that in the part of intra-platform competition '*effect from retail competition is proportionally about twice as strong compared to unbundling*' (pg 192) and it is valid until third or fourth year until introduction. After it dissipates away. Strategic decision regarding the selection of intra-platform competition in the beginning is actually logical from fixed and variable cost point of view. For example, Vipnet will firstly choose Bitstream service in a certain part of the country and pay to incumbent only for that one customer. When it acquires few customers which are based on the same part of infrastructure where entrants install their equipment on local exchange and pay collocation, fee for lines, etc., then there is option to consider LLU. With LLU operators are getting cost advantage (but only if they acquire certain number of customers because of capacity limitations) and higher freedom of service offerings to end customers. It may be one day all of those customers will be moved to their own newly built infrastructure.

Lee *et al.* (2011) find that platform competition positively influence broadband diffusion and that network effects and effects of platform co-exist in many countries in OECD countries. Lee and Marcu (2007) find that platform competition has a very significant role in cable model broadband diffusion, but DSL diffusion doesn't have. On the contrary, Gruber and Koutroumpis (2013) find that intra-platform competition has positive and significant effect, but competition among cable operators have insignificant effect on broadband uptake. One of the reasons can be the lack of infrastructure sharing. Cable is developed mainly by challengers as their main answer to incumbent infrastructure. In European Union in 2014 only four countries regulated cable infrastructure: Belgium, France, Denmark and Hungary.

Haydock *et al.* (2012) find that lower copper access prices increase the number of access seekers but discourage investments in fibre. WIK (2011) prepared model of competition for the European Competitive Telecommunication Association (ECTA) where explores

interaction between different levels of regulated access prices of new and old infrastructure and their impact on investments. They find that higher access prices for fibre and lower access prices for cooper will stimulate investments. On the other side, Plum (2011) finds that low access prices on cooper will have negative effect on investment incentives in fibre because operators are competing for the same customer on wholesale and retail level and if operator decrease cooper price it will have negative impact on demand for fibre and thus negative investment incentives for fibre. Charles River Associates CRA (2012) investigated how change in cooper price can affect incentives for investing in fibre (they used the same modelling approach and similar parameter values as used by WIK) and concluded that '*an increase in the copper access charge can provide additional incentive to invest in fibre network*' (pg 64). As opposed to WIK they assume that cooper and fibre will operate in parallel in the foreseeable future. Low access price for cooper doesn't necessarily promote investment in fibre and for certain parameters they found opposite results.

If access prices of incumbent's regulated cooper services are based on historical costs rather than current costs, or if there are excluded some common or fixed costs, significance of technology replacement is reduced (CRA, 2012). The scenario presented by WIK is possible only when you switch off cooper when the fibre network is implemented (it was one of their assumptions which in reality doesn't work).

Grajek and Röller (2009) find, based on more than 70 firms in 20 countries and over 10 years, that access regulation has negative effect on industry and individual operator investments as well as regulatory commitment problem where actually higher incumbent's investments encourage provision of access regulation.

Operators are using incumbent's infrastructure as well as their own infrastructure. There is a question are they still very dependent of incumbent's cooper based infrastructure. This paper investigates how change in LLU price affects other operators' decisions in investing in other infrastructure technologies.

Perkins (2013) finds on 131 telecommunication regulatory agencies in 80 countries that the largest source of cross-national variation is the level of regulatory institutional stability and that developed counties on average have higher regulation. Edwards and Waverman (2006) based on interconnection rates found that government influence regulatory outcomes in favor of incumbents but that institutional features which enhance regulatory independence mitigate that effect.

This paper also investigates government's influence on incumbent's, because of the fact that incumbents still has remarkable impact on the market.

3. Methodology and data

Empirical testing is based on regression static panel data analysis (with random and fixed effects). There are used Hausman test, LM and VIF test.

Data used in this study are collected from official reports/websites of regulatory authorities, European Commission, firms included into investigation and Business Monitor publications. Data about WGI are coming from World bank.

3.1. Infrastructure strategies and LLU

On EU level, 72% of subscriptions are based on DSL.

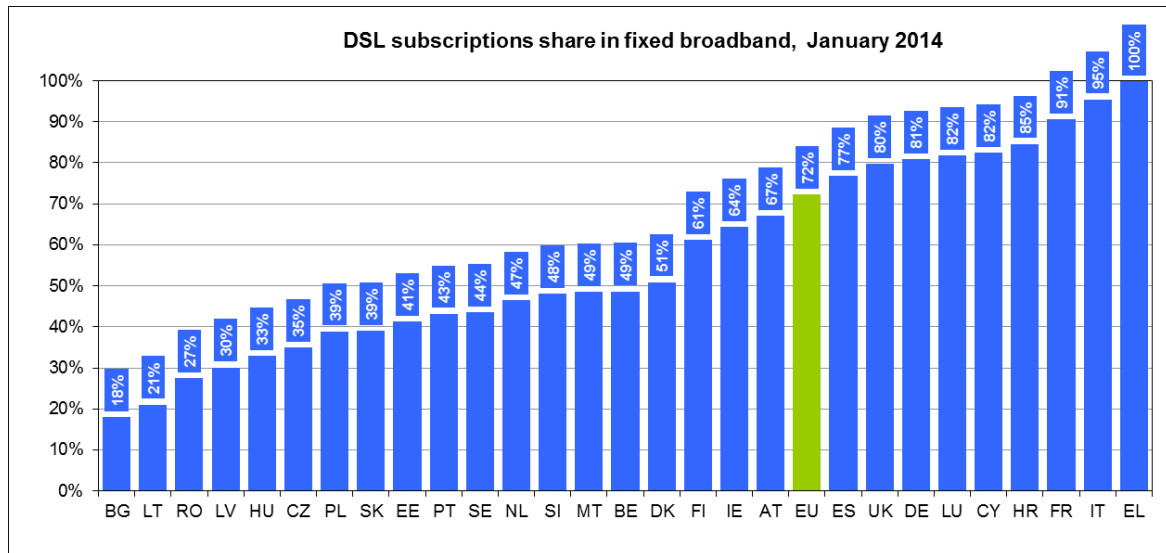


Figure 5: Proportion of DSL subscriptions on EU level

Source: European Commission

DSL are choosing mainly former monopolies, even we can notice slight grow of DSL by other operators.

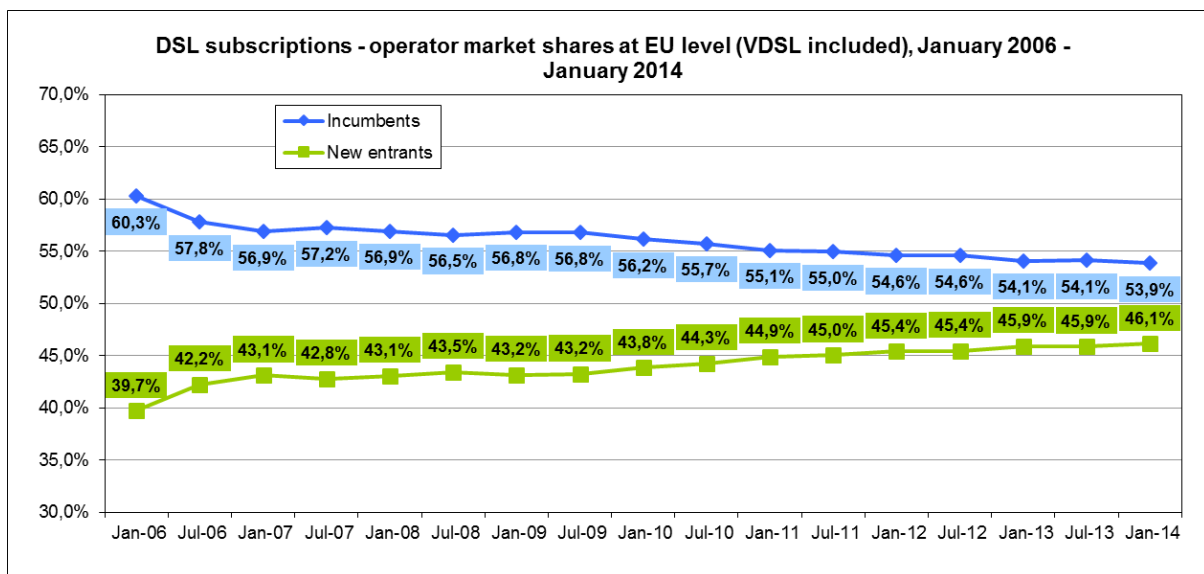


Figure 6: DSL subscriptions- incumbent and other operators

Source: European Commission

Our investigation is based on 13 European countries: Austria, Croatia, Czechia, Denmark, Estonia, Ireland, Italy, Germany, Lithuania, Netherlands, Poland, Spain and United Kingdom. The intention was to include Greece and Romania. After in depth data analysis the former two were excluded from the analysis. In Greece only incumbent has the infrastructure which it is offering to other existing operators on wholesale level. In Romania only incumbent is using infrastructure based on cooper network. Other operators are mainly using technologies based on coax cable and fibre optics.

Firms included in investigation are listed in the table below:

Table 1: Countries and firms included in investigation			
Country	Firm	Country	Firm
Austria	Liberty Global (UPC)	Ireland	Liberty Global (UPC)
Austria	Liwest	Ireland	Sky
Austria	Tele 2	Ireland	Vodafone
Austria	Other Aus	Ireland	other operators Ireland
Croatia	Iskon	Italy	Swisscom (FASTWEB)
Croatia	Optima	Italy	Tiscali
Croatia	VIPnet	Italy	VimpelCom (Wind)
Croatia	Other operators Croatia	Italy	Vodafone
Czechia	Deutsche Telekom	Italy	other operators Italy
Czechia	Liberty Global (UPC)	Lithuania	BalticumTV
Czechia	other operators CZ	Lithuania	Cgates
Denmark	Stofa	Lithuania	Dokeda
Denmark	Telenor	Lithuania	Splius
Denmark	TeliaSonera (Telia)	Lithuania	other operators Lithuania
Denmark	other operators Denmark	Netherlands	Liberty Global (UPC)
Estonia	Starman	Netherlands	Online
Estonia	STV	Netherlands	Tele2
Estonia	other operators Estonia	Netherlands	Ziggo
Germany	Tele 2	Netherlands	other operators Netherlands
Germany	Telefónica (O2)	Poland	Dialog
Germany	Vodafone	Poland	Liberty Global (UPC)
Germany	United Internet	Poland	Multimedia Polska
Germany	UnityMedia	Poland	Netia
Germany	other operators Germany	Poland	other operators Poland
Spain	Jazztel	United Kingdom	EE
Spain	ONO	United Kingdom	Liberty Global (Virgin Media)
Spain	Orange	United Kingdom	Sky
Spain	Vodafone	United Kingdom	TalkTalk
Spain	other operators Spain	United Kingdom	other operators UK

All of them offer fixed Internet access to end customers. With above mentioned firms, more than 88% (for 2014 year) of fixed Broadband customers are covered (the percentage is without 'other operators'; if we take 'other operators' than we get total market of fixed Broadband on the country level). In Germany, operator Vodafone is excluded from analysis because of the unclear infrastructure ownership over cooper network– is it owned by incumbent or is it heir own network. Investigated time period is 2010-2014.

There is an example of country Austria:

Technology	Firm	2010	2011	2012	2013	2014
DSL (Cooper)	Telekom Austria (A1)	1.013.024	1.117.192	1.186.982	1.282.264	1.355.124
DSL (Cooper)	Liberty Global (UPC)	78.900	70.200	73.000	73.800	65.900
DSL (Cooper)	Tele 2	130.000	134.000	127.000	118.000	108.000
DSL (Cooper)	Liwest	0	0	0	0	0
DSL (Cooper)	other operators	137.044	94.960	43.918	17.736	28.676
DSL (Cooper)	Total market	1.358.968	1.416.352	1.430.900	1.491.800	1.557.700
Cable	Telekom Austria (A1)	0	0	0	0	0
Cable	Liberty Global (UPC)	439.800	444.700	490.700	432.100	464.000
Cable	Tele 2	0	0	0	0	0
Cable	Liwest	50.000	50.000	50.000	60.000	75.000
Cable	other operators	124.562	148.837	114.100	201.600	202.600
Cable	Total market	614.362	643.537	654.800	693.700	741.600
Fibre optics	Telekom Austria (A1)	0	0	0	0	0
Fibre optics	Liberty Global (UPC)	0	0	0	0	0
Fibre optics	Tele 2	0	0	0	0	0
Fibre optics	Liwest	0	0	0	0	0
Fibre optics	other operators	9.462	10.854	21.000	25.300	33.100
Fibre optics	Total market	9.462	10.854	21.000	25.300	33.100
Total broadband	Telekom Austria (A1)	1.013.024	1.117.192	1.186.982	1.282.264	1.355.124
Total broadband	Liberty Global (UPC)	518.700	514.900	563.700	505.900	529.900
Total broadband	Tele 2	130.000	134.000	127.000	118.000	108.000
Total broadband	Liwest	50.000	50.000	50.000	60.000	75.000
Total broadband	other operators	271.068	254.651	179.018	244.636	264.376
Total broadband	Total market	1.982.792	2.070.743	2.106.700	2.210.800	2.332.400

Figure 7: Number of Fixed Broadband Customers per technology and operator

Source: Data collected by the author

Telekom Austria is a country's incumbent operator with market share of 58% (2014). UPC is the first challenger that build his own infrastructure and lease infrastructure from the incumbent. Tele 2 operator fully relies on incumbent's infrastructure. Other operators are building their customer base on different technologies (mostly on cable).

In Austria, DSL shares per operator are as follows:

Technology	Firm	2010	2011	2012	2013	2014
DSL (Cooper)	Telekom Austria (A1)	100%	100%	100%	100%	100%
DSL (Cooper)	Liberty Global (UPC)	15%	14%	13%	15%	12%
DSL (Cooper)	Tele 2	100%	100%	100%	100%	100%
DSL (Cooper)	Liwest	0%	0%	0%	0%	0%
DSL (Cooper)	other operators	51%	37%	25%	7%	11%
DSL (Cooper)	Total market					

Figure 8: Share of customers on incumbent's DSL infrastructure, per operator

Source: Data collected by the author

These numbers will be compared with LLU price. Even though operators are using different wholesale services, for this investigation purposes they will be summarized on one main service - LLU (for all of them the starting point from cost and infrastructure point of view is LLU; LLU price increase will reflect price increase in Bitstream service).

3.2. WGI and incumbent market share

Empirical investigation is based on 19 European countries: above mentioned countries plus France, Bulgaria, Slovakia and Hungary. Investigated time period is 2010-2014.

Incumbents around European Union have different impact in their own markets, as can be seen in the following graph:

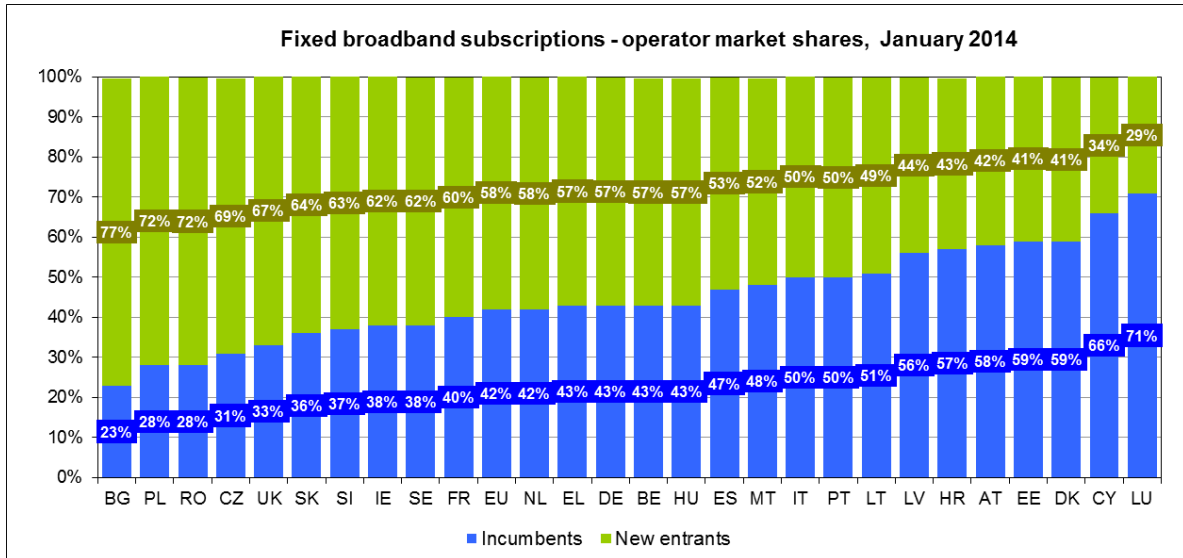


Figure 9: Operator market share

Source: European Commission

In 10 European countries they have market share above 50%. Such situation can be explained by their efficiency, competitive aggressiveness, technological advantage, regulatory environments, and etc.

We are investigating influence of governance indicators: Regulatory quality, Government effectiveness and Control of corruption on incumbent's market share.

Indicators are defined as follows (Kaufmann *et al*, 2008):

Regulatory quality - *measure perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development,*

Government Effectiveness - *perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies and*

Control of Corruption - *perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.*

4. Results and discussion

Below there are presented tested results.

Technological strategies and LLU

Fixed-effects (within) regression		Number of obs	=	285
Group variable: Firmcode		Number of groups	=	57
R-sq: within	= 0.0174	Obs per group: min	=	5
between	= 0.1158	avg	=	5.0
overall	= 0.0899	max	=	5
corr(u_i, Xb)	= -0.4227	F(1,227)	=	4.01
		Prob > F	=	0.0463

DSLShare	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
ULL	-.0261048	.0130317	-2.00	0.046	-.0517833	-.0004262
_cons	.7047991	.1115727	6.32	0.000	.4849486	.9246497
sigma_u	.46431401					
sigma_e	.14482943					
rho	.91133204	(fraction of variance due to u_i)				

F test that all u_i=0:	F(56, 227) =	42.21	Prob > F =	0.0000
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Figure 10: Technological dependency on incumbent's LLU price - Fixed effects

Random-effects GLS regression		Number of obs	=	285
Group variable: Firmcode		Number of groups	=	57
R-sq: within	= 0.0174	Obs per group: min	=	5
between	= 0.1158	avg	=	5.0
overall	= 0.0899	max	=	5
corr(u_i, X)	= 0 (assumed)	Wald chi2(1)	=	0.37
		Prob > chi2	=	0.5443

DSLShare	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
ULL	-.0072167	.0119017	-0.61	0.544	-.0305436	.0161102
_cons	.5435649	.1162933	4.67	0.000	.3156342	.7714955
sigma_u	.41497876					
sigma_e	.14482943					
rho	.89142123	(fraction of variance due to u_i)				

Figure 11: Technological dependency on incumbents LLU price - random effects

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Breusch and Pagan Lagrangian multiplier test for random effects

DSLShare[Firmcode,t] = Xb + u[Firmcode] + e[Firmcode,t]

Estimated results:

```

	Var	sd = sqrt(Var)
DSLShare	.2102387	.458518
e	.0209756	.1448294
u	.1722074	.4149788

```

Test:  Var(u) = 0
      chibar2(01) = 429.59
      Prob > chibar2 = 0.0000

```

Figure 12: LM test - Technological dependency on incumbent's LLU price

LM multiplier shows that we should reject pooled OLS in favor of Random effect model.

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. hausman fe re

      _____ Coefficients _____
      (b)          (B)          (b-B)      sqrt(diag(V_b-V_B))
      fe          re          Difference      S.E.
-----+-----+-----+-----+-----
ULL          -.0261048    -.0072167    -.0188881    .005308

      b = consistent under Ho and Ha; obtained from xtreg
      B = inconsistent under Ha, efficient under Ho; obtained from xtreg

      Test: Ho: difference in coefficients not systematic

      chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
              =      12.66
      Prob>chi2 =      0.0004
    
```

Figure 13: Hausman test - Technological dependency on incumbent's LLU price

Hausmanov test tell us the model with fixed effects is better than model with random effects.

LLU price has negative influence on firms' strategies related to cooper network infrastructure leased by incumbents.

In presented results there are included 'other operators'. Even if we exclude 'other operators', the conclusion stays the same.

```

Fixed-effects (within) regression
Group variable: Firmcode

R-sq:  within = 0.0397
       between = 0.1054
       overall = 0.0799

corr(u_i, Xb) = -0.4524

Number of obs   =    220
Number of groups =    44
Obs per group: min =     5
               avg  =    5.0
               max  =     5

F(1,175)       =     7.24
Prob > F       =    0.0078
    
```

DSLShare	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
ULL	-.0405259	.0150636	-2.69	0.008	-.0702557	-.0107961
_cons	.88073	.1289671	6.83	0.000	.6261989	1.135261
sigma_u	.50237944					
sigma_e	.14358618					
rho	.92448047 (fraction of variance due to u_i)					

```

F test that all u_i=0:      F(43, 175) =    48.68      Prob > F = 0.0000
    
```

Figure 14: Technological dependency on incumbent's LLU price - without 'other operators'

WGI and incumbent's market share

Results from Stata are as follows:

Incsharen	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
ControlofcorruptionLn	.0139947	.0118147	1.18	0.240	-.0095521	.0375414
RegulatoryQualityLn	.2954712	.0729836	4.05	0.000	.1500151	.4409273
effektLn	-.3218965	.0831	-3.87	0.000	-.4875147	-.1562784
_cons	-.8419336	.0095984	-87.72	0.000	-.8610632	-.822804
sigma_u	.26171535					
sigma_e	.06020823					
rho	.94973609	(fraction of variance due to u_i)				

F test that all u_i=0: F(18, 73) = 76.55 Prob > F = 0.0000

Figure 15: Influence of WGIs on incumbent's market share - Fixed effects

Incsharen	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
ControlofcorruptionLn	.0138557	.0117314	1.18	0.238	-.0091374	.0368488
RegulatoryQualityLn	.2631159	.0694139	3.79	0.000	.1270672	.3991646
effektLn	-.2902328	.0752642	-3.86	0.000	-.4377478	-.1427177
_cons	-.8393341	.0588329	-14.27	0.000	-.9546444	-.7240239
sigma_u	.25183265					
sigma_e	.06020823					
rho	.94593114	(fraction of variance due to u_i)				

Figure 16: Influence of WGIs on incumbent's market share - Random effects

```

Breusch and Pagan Lagrangian multiplier test for random effects

Incsharen[Countrycode,t] = Xb + u[Countrycode] + e[Countrycode,t]

Estimated results:

```

	Var	sd = sqrt(Var)
Incsharen	.0573782	.2395374
e	.003625	.0602082
u	.0634197	.2518326

```

Test:  Var(u) = 0
      chibar2(01) = 153.69
      Prob > chibar2 = 0.0000

```

Figure 17: LM test - Influence of WGIs on incumbent's market share

LM multiplier shows that we should reject pooled OLS in favor of Random effect model.

```

. hausman fe re

```

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) fe	(B) re		
Controlofc~n	.0139947	.0138557	.000139	.0014011
Regulatory~n	.2954712	.2631159	.0323553	.0225459
effektLn	-.3218965	-.2902328	-.0316638	.0352267

```

      b = consistent under Ho and Ha; obtained from xtreg
      B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test:  Ho: difference in coefficients not systematic

      chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
            =      4.60
      Prob>chi2 =      0.2036

```

Figure 18: Hausman test - Influence of WGIs on incumbent's market share

Hausmanov test tell us the model with random effects is better than model with fixed effects.

```

. vif

```

Variable	VIF	1/VIF
effektLn	3.16	0.316915
Regulatory~n	2.75	0.364229
Controlofc~n	1.45	0.691747
Mean VIF	2.45	

Figure 19: Colinearity of independent variables

VIF is below 5, that means there is no collinearity between independent variables.

Above presented results and tests show that WGIs have an impact on incumbent's market share. Control of corruption has positive effect but is not statistically significant. Regulatory quality has positive effect – the higher regulatory quality, the higher incumbent's market share. Government effectiveness has negative effect on incumbent's market share.

5. Conclusion

This paper investigates the influence of regulatory pressure on firms in telecommunication industry in part of fixed Internet access and impact of governance indicators on incumbent's market share.

Telecommunication industry is known as very regulated industry, especially in the fixed part of access network. Hence regulatory agencies have an important role and responsibility in the process of setting up and maintaining competitive environment under the era of the fast technological development. Regulation is explained under institutional theory to be a formal part of institutional context which make firms to become homogeneous in their activities and structures. According to institutional theory successful firms are those that conform to social pressures and achieve legitimacy, not those that achieve competitive advantage. To regulate former monopolies is not an easy process. Different complex and sophisticated costing methodologies are used which have to produce access prices/costs which need to take into account many aspects of business, including the future demand for services, investments in new technological solutions and capacity, competitive environment, etc. Decisions done by regulatory agencies can even exacerbate or mitigate risks of firms in industry. How regulatory environment is important to operators, telling the investigation done by consultants from EY (EY, 2015) where uncertain regulatory environment is positioned in the second place (after disruptive competition).

There are two ways to enter incumbent's access market: Carrier selection and unbundling (Local Loop unbundling, Subloop unbundling, Line sharing and Bitstream). Scholars mostly investigated which type of access will have stronger influence of broadband uptake and on investments in new technologies.

Operators, according to their preferences to achieve competitive advantage, are also choosing to invest in other technologies (based on coax cable and fibre optics).

Results of our investigation based on 13 countries and time period of 5 years show that operators (entrants) are leasing infrastructure from the incumbent and investing into their own infrastructure in order to differentiate from incumbent and achieve higher rents. Regulatory pressure is expressed in price of LLU. Change in LLU price impacts their decisions whether to invest in infrastructure or lease it from incumbent. LLU price has negative effect on operators customer share on DSL technology – price increase has negative influence on customer base on incumbent's infrastructure. Entrants are evidently still dependent of incumbent's infrastructure and sensitive on LLU price changes.

In some countries incumbent still has significant impact on the market. One of the reasons can be because of inadequate institutional context. We investigated influence of governance indexes: Regulatory quality, Government effectiveness and Control of corruption on incumbent's market share. Results show that Control of corruption has positive effect on incumbent's share but is not statistically significant. Regulatory quality has statistically significant and positive effect, while Government effectiveness has statistically significant and negative effect on incumbent's market share.

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