Institute of Economic Studies, Faculty of Social Sciences
Charles University in Prague

Evidence for a ladder of investment in Central and Eastern European countries

Matt Hunt
Goran Serdarević
Tom Ovington
Clive Kenny

IES Working Paper: 13/2014

Institute of Economic Studies,
Faculty of Social Sciences,
Charles University in Prague

[UK FSV – IES]

Opletalova 26
CZ-110 00, Prague
E-mail : ies@fsv.cuni.cz
http://ies.fsv.cuni.cz

Institut ekonomických studií
Fakulta sociálních věd
Univerzita Karlova v Praze

Opletalova 26
110 00 Praha 1

E-mail : ies@fsv.cuni.cz
http://ies.fsv.cuni.cz

Bibliographic information:
Hunt, M.,Serdarević G., Ovington, T., Kenny, Clive. (2014). "Evidence for a ladder of investment in Central and Eastern European countries" IES Working Paper 13/2014. IES FSV. Charles University.

This paper can be downloaded at: http://ies.fsv.cuni.cz

Evidence for a ladder of investment in Central and Eastern European countries

Matt Hunt[a]
Goran Serdarević[a,b]
Tom Ovington[a]
Clive Kenny[a]

[a] Frontier Economics Ltd.
71 High Holborn
London WC1V 6DA
United Kingdom

[b] Charles University in Prague, Institute of Economic Studies, Faculty of Social Sciences
Opletalova 26
Prague 110 00
Czech Republic
E-mail: goran.serdarevic@gmail.com

corresponding author

May 2014

Abstract:

The model of liberalisation of European telecommunications markets had followed what has become known as the "ladder of investment" (LoI) hypothesis: under this hypothesis entrants are expected to make progressively greater investments in their own networks, whilst decreasing their dependence on the network of the incumbent fixed operator. The ultimate goal of the LoI approach is to achieve, where feasible, inter-platform competition.

From a theoretical perspective, there are opposing forces at work: whilst offering retail services based on access to the incumbent's network at the 'first rung' of the ladder is less risky, access seekers may find that investing to step-up on the 'second and higher rungs' of the ladder too risky. It is therefore unclear from a theoretical perspective whether the LoI approach will lead to inter-platform competition. Whether and under what circumstances it would is thus an empirical question.

Our paper focuses on the evidence for the LoI in Central and Eastern European (CEE) countries. Our analysis shows that the evidence available for CEE is consistent with entrants in CEE countries largely by-passing the LoI, by directly investing in their own networks. There are good reasons for this, as some of the assumptions underlying the LoI theory, such as good quality and universally available copper networks and relatively high cost and risk of investing in alternative infrastructure, do not necessarily hold in CEE countries.
Our paper's results are broadly consistent with most of the existing literature and represents a valuable contribution by providing an insight into the applicability of the LoI to CEE countries.

Acknowledgements:

The opinions expressed in this article are the authors' own and do not reflect the views of Frontier Economics Ltd.

The corresponding author would like to acknowledge financial support from the Czech Science Foundation (GACR 403/10/1235 – Institutional Responses to Financial Market Failures).

1 Introduction

EU policy making in the area of telecommunications has aimed to improve consumer outcomes by seeking to facilitate, amongst other, competition between fixed line operators. If consumers can choose between number of competing operators which offer fixed telecommunications services regulation of incumbents' services could be rolled back. The most desirable form of competition would be 'inter-platform' competition (or infrastructure or end-to-end competition), where alternative fixed operators built their own networks to compete with the fixed, copper based, incumbents. Thus "inter-platform" competition[1] offers the most promising potential to roll back regulation and rely to a greater extent on markets[2].

Furthermore, it is generally accepted that, as inter-platform competition allows competition across the whole of the value chain, it increases the potential for innovation, and improves the incentives to invest and to decrease costs[3]. All else the same therefore, where feasible and sustainable, inter-platform competition is more desirable than access-based competition (different providers supplying services to consumers, using wholesale access products based on a fixed incumbent operator's infrastructure).

However, the extent to which inter-platform competition is feasible has been widely debated. Certain parts of an incumbent's network have been considered not to be replicable, in particular large parts of the access network. This is because of the large sunk costs that entrants would need to incur to duplicate such networks and the significant local economies of scale which the incumbent operator benefits from.

In the 1990s, concerns about the extent to which inter-platform competition may be feasible led to increasing interest in regulatory policies which enable access-based competition.[4] The advantage of this sort of policy is that it can deliver

---

1 Throughout this paper, we use the terms inter-platform competition and infrastructure-based competition as equivalents.

2 This, for example, has been the approach in Hong Kong. As a large proportion of households are able to choose between two or three different providers that separately operate their own infrastructure, regulated access to the local loop was removed from the incumbent operator. See, for example, Legislative Council Brief, Review of Type II Interconnection Policy, 6 July 2004.

3 "*A corollary of the belief in the advantages of competition is that it should extend across the whole of, or as much as possible of, the value chain.* […] *The medium and long-run desirable outcome is, however, competition on level terms among operators of the kind which is already found in mobile markets.*" Cave, M. (2006), "Encouraging infrastructure investment via the ladder of investment", Telecommunications Policy 30, pp. 223-237.

4 For more information on the access-based regulatory approach in the European telecommunications sector see Stehman, O. and R. Borthwick (1994) "Infrastructure competition and the European Union's telecommunications policy" Telecommunications Policy 18, pp. 601-615.

improvements in competition over a part of the supply chain if successfully implemented. However, as less of the supply chain is open to competition under access-based entry compared to inter-platform competition the welfare gains associated with access-based competition are likely to be more limited.

By the early 2000s, the emergence of broadband as a new mass market product provided a significant opportunity for entrants and changed the economics of entry using the incumbent's infrastructure.[5] It was at this time that the concept of the Ladder of Investment (LoI) gained prominence among European regulators. The LoI provided an apparent solution to the dilemma faced by regulators wanting to promote competition while not inhibiting incentives for entrants to invest in their own infrastructure; it proposes that rather than viewing access-based entry and platform based entry as substitute forms of competition, that they should be seen as sequential complementary steps.

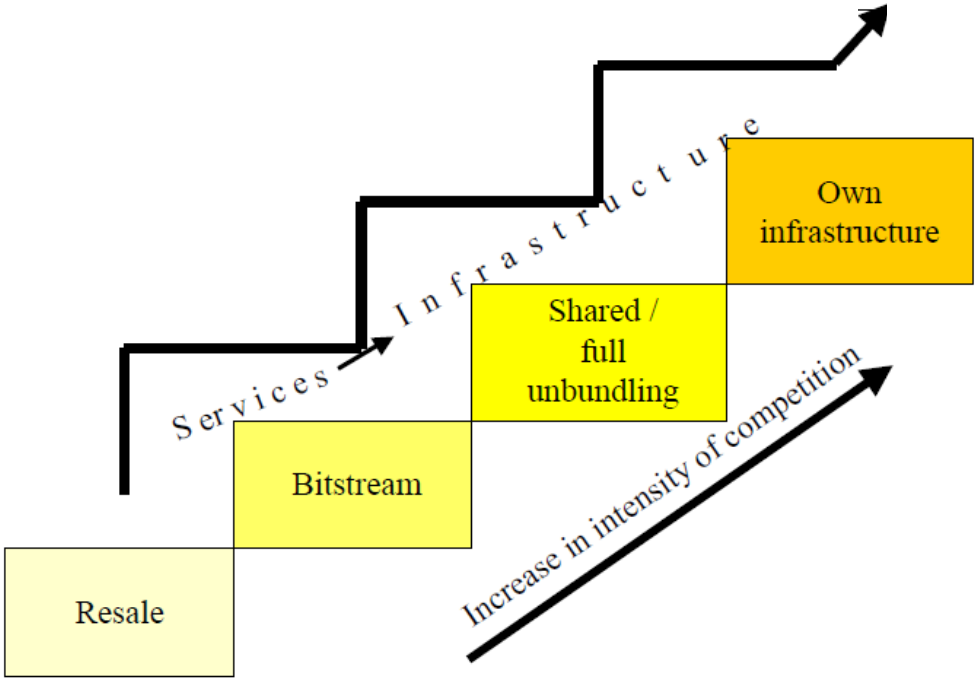
The LoI envisages a phase of service competition where entrants rely on regulated access to the incumbent's network. Entrants could initially compete by re-selling the incumbent's services. Progressively they can build a customer base, brand and gain knowledge and experience and can overcome some of the barriers to entry which may otherwise inhibit investment in infrastructure. As they grow they can iteratively invest in their networks and "climb rungs of the investment ladder". Eventually, entrants may reach sufficient size and scale to be able to replicate access networks and compete directly with the incumbent's own network infrastructure. This gradual climbing of the "rungs" on the ladder is illustrated in **Figure 1** by different models of competition in broadband markets. Where entrants only climb lower levels of the ladder, and only compete by using the incumbent's access products there is said to be a "partial LoI". Where entrants progressively compete further up the ladder and ultimately invest in their own access infrastructure, there is said to be a "full LoI".[6]

---

5 In particular, to provide broadband services required the incumbent operator to invest in new equipment in its local exchange buildings. It became feasible for entrants to also invest in such equipment, which could be co-located in the incumbent's buildings and use its access network, thus benefiting from the incumbent's economies of scale. As the capabilities of the equipment advanced it allowed entrants to provide both broadband and voice services. This offered entrants economies of scope and reduced their reliance on the incumbent operator's wholesale voice services. At the same time, the incentives of entrants to invest in their own access network infrastructure also changed as broadband provided additional revenue streams.

6 We use the terminology broadly consistent with Bachache et. al, (2013) where our "partial LoI" is referred to as "short ladder" and our "full LoI" is equivalent to "complete ladder".

Figure 1. An illustration of the LoI



Source: ERG (05) 23

The acceptance of the LoI framework by European telecommunications regulators is exemplified by the common position published by the European Regulators Group (a group representing the EU regulators) in 2003 on the approach to appropriate remedies in the new regulatory framework, which described the LoI approach to access regulation and made clear that the ultimate goal is sustainable inter-platform competition where feasible[7].

1.1 Use of the LoI concept in competition law

More recently, the LoI has been adopted by competition authorities to describe the model of entry and expansion that is observed in broadband markets. In two cases in recent years (a 2007 abuse of dominance decision against Telefonica[8] in

---

7 ERG (03) 30rev1 ERG Common Position on the approach to Appropriate remedies in the new regulatory framework, page 68 "In those areas where infrastructure based competition is feasible, such interventions have as their long-term objective the emergence of self-sustaining effective competition and the ultimate withdrawal of regulatory obligations."

8 Commission decision of 4 July 2007 relating Case COMP/38.784 – Wanadoo España vs. Telefónica [hereinafter Telefonica decision]

Spain and a 2011 decision against Telekomunikacja Polska[9] in Poland) the European Commission partly based its assessment of the effect of the anti-competitive conduct on its view that absent such conduct entrants would have climbed the LoI.

In both its decisions the Commission noted that "*when constructing a new alternative telecommunications infrastructure, it is of crucial importance to obtain a minimum "critical network size" in order to fully benefit from network effects and economies of scale and be able to make further investments. This phenomenon is commonly referred to as the 'investment ladder' by economists and regulators*"[10]. The Commission found that the incumbent's refusal to supply wholesale access to its infrastructure and services "*slowed down the progress of [Alternative Operators] along the investment ladder" [as such entrants were] "not able to build a customer base large enough to sustain considerable investments in their own infrastructure*"[11] which resulted with the limited development of alternative infrastructures.

However, it is not obvious that the development of competition in broadband markets should follow a similar pattern in Spain and Poland. Spain and Poland, in line with many other Western European (WE) and Central and Eastern European (CEE) countries respectively, had very different market characteristics which would be expected to affect the development of broadband markets. For example, their legacy access networks had different levels of coverage with different penetration of fixed lines, the access networks were of different quality and so differed in how they could support broadband services and the costs of investing in alternative infrastructure differed.

The motivation of this paper is to consider whether there is evidence of a LoI in CEE countries. In particular, our interest is to assess whether the available evidence shows that entry and expansion in CEE countries is consistent with a LoI hypothesis.

2 Literature review

In this section we describe the theoretical considerations underlying the LoI and summarise the existing empirical findings on the existence of a LoI

9 Commission decision of 22 June 2011 relating Case COMP/39.525 – Telekomunikacija Polska [hereinafter PT decision]

10 Telefonica decision paragraph 177

11 PT decision paragraph 604

2.1 The theoretical foundations of the LoI theory

The LoI regulatory framework was first formally proposed by Cave and Vogelsang (2003)[12] and was further formalised by Cave (2006)[13]. For example, in his 2006 paper Cave set out a six-step process which described how regulators could implement LoI policies to promote inter-platform competition via a phase of access-based competition.

Cave argued that regulators could actively influence the dynamics of competition in broadband markets. By increasing access charges at the lower 'rungs' of the ladder (e.g. resale or bitstream services) or by withdrawing access obligations after some pre-determined date, the regulators could induce new entrants to climb the ladder and move towards the objective of sustainable inter-platform competition, where feasible.

However, the literature generally recognises two opposing effects that access-based entry has on the incentives to invest in infrastructure-based entry: the "replacement effect" and the "stepping stone effect"; see for instance Bourreau et al, 2010[14].

- The replacement effect describes how access regulation can reduce the incentives of a new entrant to invest in infrastructure-based entry. This can occur if the price of wholesale access products are set favourably for entrants as this creates an "opportunity cost" for operators considering investing in infrastructure.[15] The higher the profits that can be obtained under access-based competition, the higher the replacement effect.

- On the other hand, the stepping stone effect implies that a period of access-based entry allows the entrant to gain knowledge, experience and gradually build brand and a subscriber base. In this way access-based entry may accelerate infrastructure-based entry.

The opposing nature of these effects implies that the LoI theory holds if the conditions in the market are such that the stepping stone effect is stronger than the replacement effect. Therefore regulators can attempt to use regulatory tools

---

12 Cave, M. and Vogelsang, I. (2003), "How Access Pricing and Entry Interact", Telecommunications Policy 27, pp. 717-727.

13 Cave, M. (2006), "Ecouraging infrastructure investment via the ladder of investment", Telecommunications Policy 30, pp. 223-237.

14 Bourreau, M., Dogn, P. and M. Manant (2010) "A critical review of the "LoI" approach", Telecommunications Policy, vol. 34, pp 683-696

15 See for instance Crandall, R. W., Ingraham, A. T. and Singer, H. J. (2004), Do Unbundling Policies Discourage CLEC Facilities-Based Investment?" Topics in Economic Analysis and Policy, 4(1), article 14.

to affect the balance between these two effects. An example would be wholesale access prices increasing over time, as proposed by Cave (2006).

This implies that whether a period of access-based competition leads to greater investment in alternative infrastructure is ultimately an empirical question.

2.2 The empirical evidence of the LoI theory

We describe below the empirical academic literature that seeks to test the LoI hypothesis.

The empirical research in this area was initially focused on the US and suggested that mandatory unbundling of the local loop (ULL) had a negative impact on investments in access networks by incumbents and alternative operators.[16] Later there have been a number of empirical papers investigating the relationship between access regulation and investment in alternative infrastructures in Europe. These papers also largely found that greater access regulation, represented by lower ULL prices or higher take up of ULL, has a negative impact on infrastructure-based entry. For example, Grajek and Röller (2009)[17] find that access regulation has a negative impact on investment by both incumbent and entrant operators, and these results are in line with the findings reported by others including Friederiszick et al. (2008).[18]

In view of the evolution towards next generation networks, a strand of the literature has focused on the effect of access regulation on investment in new fibre networks. For example Wallsten and Hausladen (2009)[19], empirically examine the relationship between ULL and investment in new fibre networks, using data for 27 European countries from 2002 to 2007. They find that the number of unbundled DSL connections per capita is negatively correlated with the number of fibre connections. Similarly, Briglauer et al (2011)[20] estimate the

---

16 See for example Crandall et al (2004) or Hausman, J. and G. Sidak (2005): "Did mandatory unbundling achieve its purpose? Empirical evidence from five countries" Journal of Competition Law and Economics, 1(1), 173-245. Note that it is standard in the literature to proxy the level of infrastructure-based investment by the number of infrastructure-based lines.

17 Grajek, M and L. –H. Roller (2009): "Regulation and Investment in Network Industries: Evidence from European Telecoms", Working Paper, ESMT No.09-004.

18 Friederiszick, H., M. Grajek and L.-H. Roller (2008): "Analyzing the Relationship between Regulation and Investment in the Telecom Sector", March 2008.

19 Wallsten, S. and S. Hausladen (2009): "Net Neutrality, Unbundling, and their Effects on International Investment in Next-Generation Networks", *Review of Network Economics*, Vol.8, Issue 1 – March 2009.

20 Briglauer, W. G. Ecker and K. Gugler (2011): "Regulation and Investment in Next Generation Access Networks: Recent Evidence from the European Member States", working paper available at. http://epub.wu.ac.at/3291/

impact on FTTx deployment using data from the EU27 member states for the years 2005 to 2010. They find that a stricter previous ex ante regulation has led to a negative impact on FTTx infrastructure investment.

More recently, authors have sought to consider a more complete picture of the LoI theory, considering not just the impact on take up or investment in alternative infrastructure, but also the extent to which there is evidence of "climbing the ladder". For example, Bacache et al. (2013)[21] distinguish between three modes of entry: bitstream access, ULL and new access facilities. Using data from 15 European countries for the period 2002-2010 they find that bitstream access seems to foster ULL take up, but they did not find evidence that the adoption of ULL leads to investment in new access infrastructures. Garrone and Zaccagnino (2011)[22] have found similar results using a wider sample of 29 European countries over the period 2002-2009. They again find support for the 'partial LoI' version of the theory, that initial usage of resale and bitstream access products leads to subsequent entry through unbundling, but do not find that access-based ULL entry leads to subsequent infrastructure-based entry.

These papers, however, provide only a limited indication of if and how the LoI has worked in CEE countries[23]. As explained below, there are significant differences in the development of competition in CEE and WE countries[24], which the existing empirical studies do not capture, partly due to the lack of sufficiently long data series from the CEE region.

Below, we provide a descriptive analysis of a dataset covering key broadband metrics in the EU member states over the period 2004-2011. The analysis illustrates the main differences in the nature of competition in broadband markets in CEE and WE countries. We also offer a preliminary view on the existence of the LoI in the CEE region.

---

21 Bacache, Maya, Bourreau, Marc and Gaudin, Germain (2013): "Dynamic Entry and Investment in New Infrastructures: Empirical Evidence from the Telecoms Industry" Telecom ParisTech

22 P. Garrone and M. Zaccagnino (2011): "The relationship between local loop unbundling and the deployment of alternative broadband networks. An empirical analysis", working paper.

23 In this paper we use the term "Central Eastern European countries" for the following EU member states: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia, Bulgaria and Romania.

24 For simplicity, we use the term "Western European countries" for all EU member states outside CEE: Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, Netherlands, Austria, Portugal, Finland, Sweden, United Kingdom, Cyprus and Malta. The more accurate term would be "Western, Northern and South European countries".

3 Results and discussion

In this section we consider the evidence for a partial LoI or full LoI approach to entry and expansion in CEE countries and compare it to the evidence for WE countries.

3.1 Development of competition in broadband markets

We have examined data from the European Commission on the number of retail broadband connections in the 27 European Union countries between 2004 and 2011. The data identifies whether each connection provided by a non-incumbent is a resale of the incumbent's service, bitstream, ULL, or broadband using the entrant's own access infrastructure.

Looking at the uptake of bitstream and ULL, it is immediately obvious that competition in CEE and WE countries has evolved in very different ways. CEE countries have relied far less on the incumbent's access products. In CEE countries, on average less than 10% of broadband connections are provided by access products (whether resale, bitstream or ULL) throughout the period 2004-2011, see **Figure 2** below. In contrast, in WE countries the use of access products has consistently been above 20%.

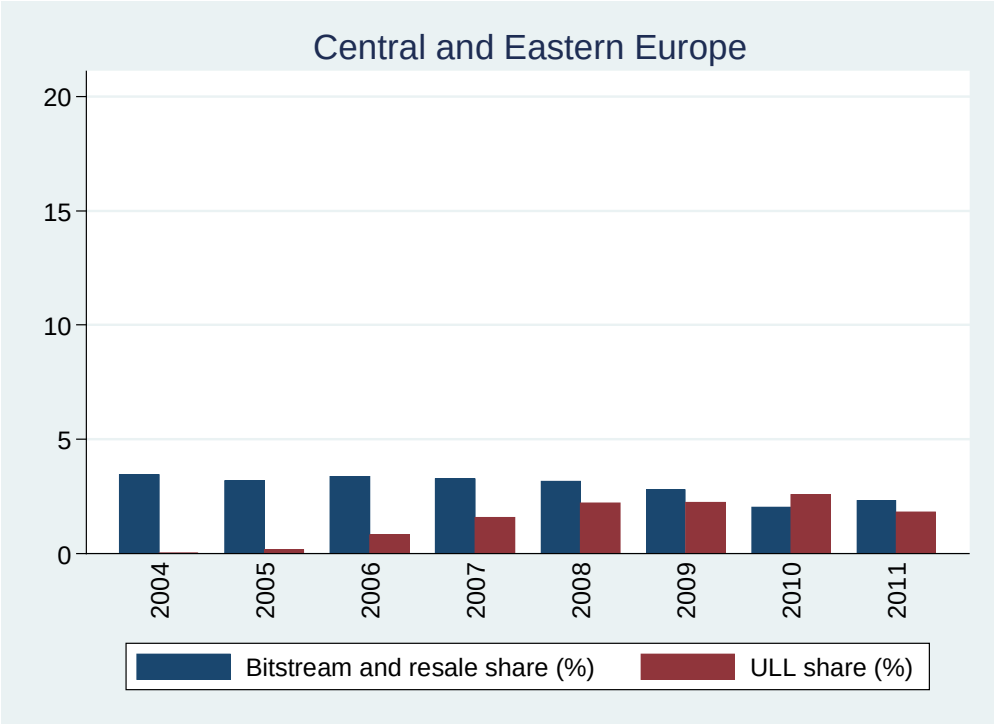
If competition in broadband markets followed the partial LoI we would expect to observe entrants initially competing using the incumbent's access-based products (resale and bitstream) and then over time investing deeper into the network and competing using ULL based products. As can be seen in **Figure 2** this pattern is not observed in CEE countries. The share of broadband connections provided over access-based wholesale products (resale and bitstream) has stayed relatively stable at a level below 5%, declining slightly in the recent years[25]. At the same time, while ULL's share is increasing over time, it has not grown above 3% of broadband connections. This does not seem to be consistent with the hypothesis that a partial LoI describes the development of competition in CEE countries. This stands in contrast to the overall trends in WE countries. In these countries, bitstream's[26] share of fixed broadband connections reached a peak in 2004 and has since fallen whilst ULL has increased.

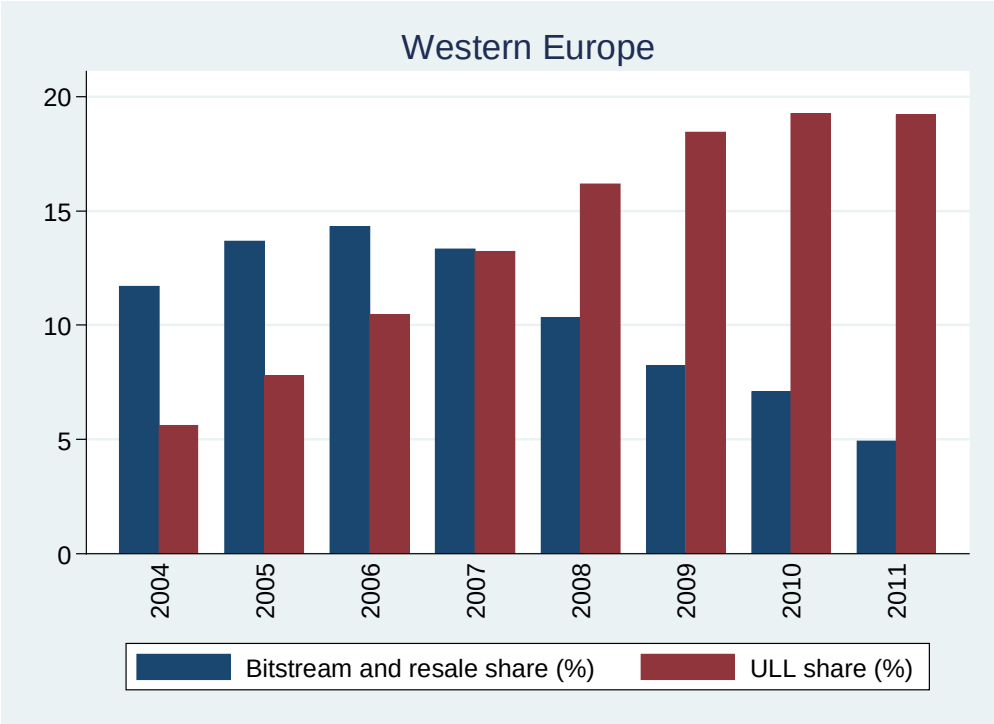
---

25 The share of broadband connections is calculated as the unweighted average across the 10 CEE countries, and 17 WE countries respectively.

26 For simplicity, hereafter, when referring to 'bitstream' products, we consider both resale of incumbent services and various forms of bitstream wholesale access into incumbent's network.

Figure 2. Use of incumbent's wholesale broadband access products bitstream and resale vs. ULL (share of fixed broadband connections)



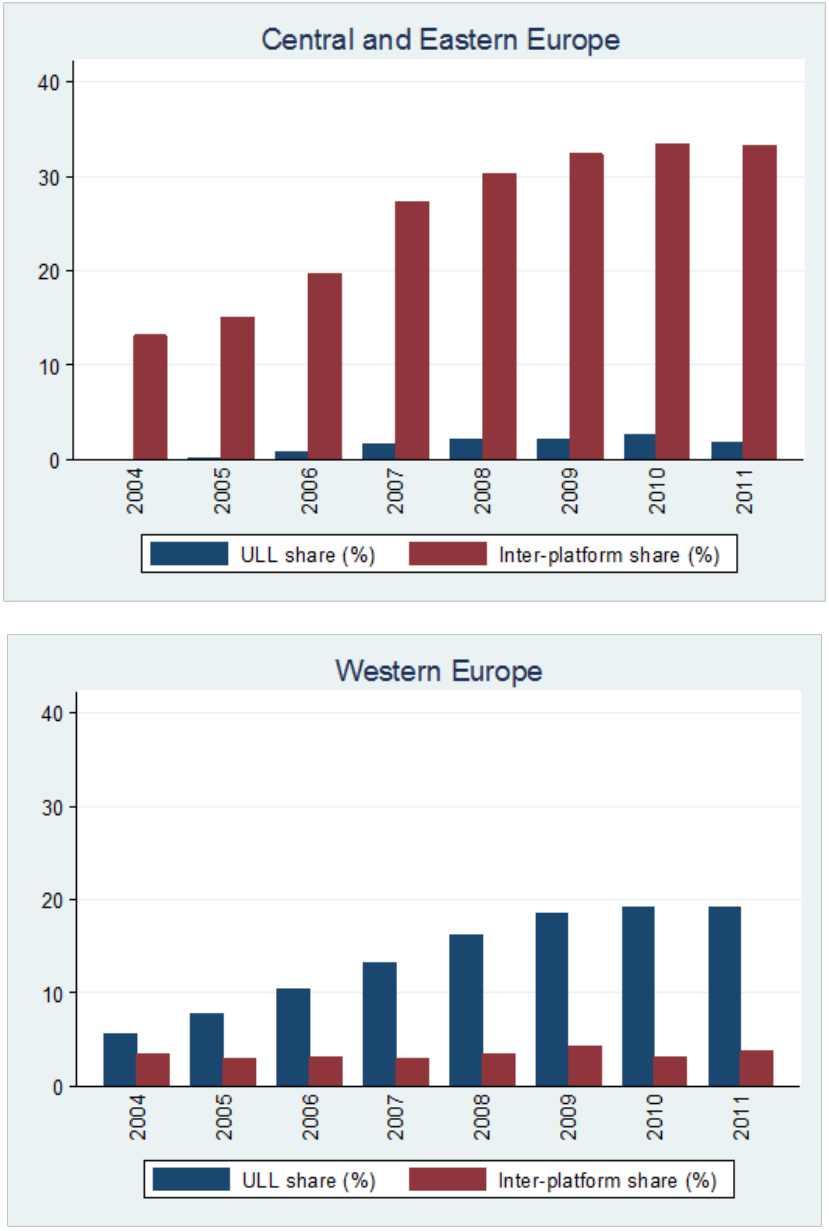


Notes: The share of broadband connections is calculated as the unweighted average across the 10 CEE countries, and 17 WE countries respectively.

Looking at the take up of broadband services based on alternative infrastructures, we can further illustrate the differences between the two regions. **Figure 3** shows that CEE countries have had a significantly higher share of broadband connections provided by entrants' alternative (non-DSL) infrastructures than WE countries. Since 2009, the share of broadband connections provided by these alternative infrastructures has been above 30%[27]. The high share of alternative broadband technologies and relatively low share of connections provided over the incumbent network is consistent with entrants in CEE countries managing to by-pass the LoI.

27 We have excluded cable from our measure of inter-platform competition since entrants are unlikely to move from access-based products to rolling out a cable network. We recognise that the presence of cable operators might also have an impact on the decision on the preferred form of entry. In particular, the ability of cable operators to offer broadband services that are difficult to match by using DSL technology might have also contributed to higher investment into own (often FTTx-based) infrastructure in many CEE countries. We therefore include cable in our measure of inter-platform competition when testing robustness of our econometric results, without any significant impact on our overall results and conclusions.

Figure 3. Use of incumbent's ULL products vs. infrastructure-based access (share of broadband connections)



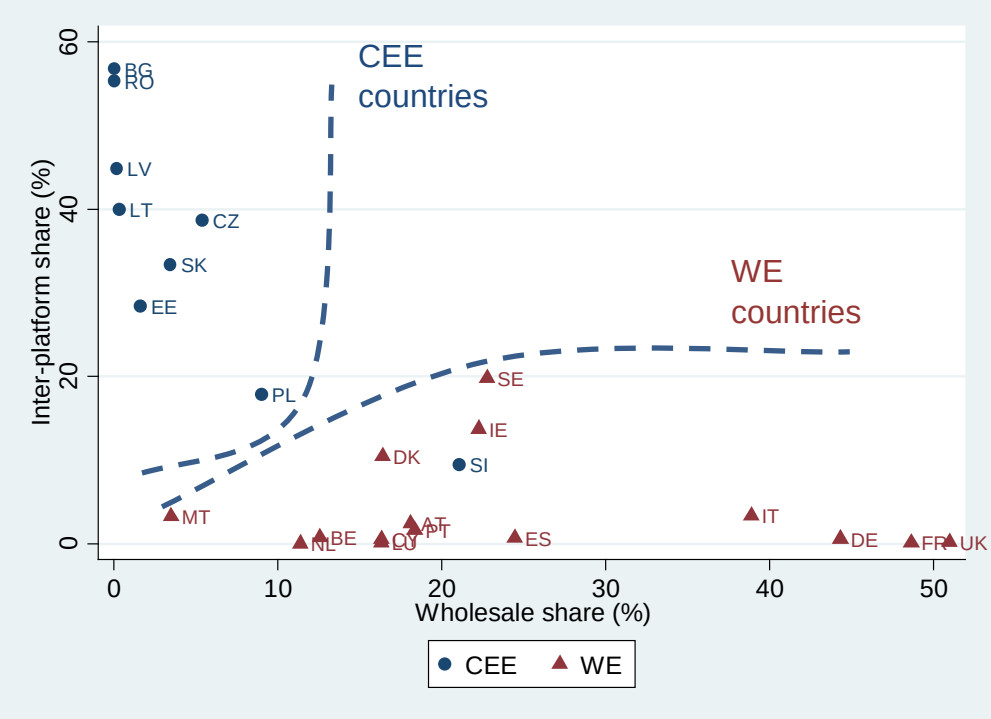
Notes: The share of broadband connections is calculated as the unweighted average across the 10 CEE countries, and 17 WE countries respectively.

Inter-platform share refers to the share of new entrants' connections made with a non-DSL (excluding cable) technologies.

As discussed in Section 3.3 below we find that the econometric analysis provides further support that neither the partial nor the full LoI describes how competition has evolved in CEE countries.

So far we have presented aggregate results for the WE and CEE regions. Looking at the evolution of competition in individual countries provides a further insight into the LoI theory (see Annex for detailed graphs). As shown in **Figure 4** below, in most CEE countries (with the exception of Slovenia) there is very low uptake of bitstream or ULL. Whereas in most WE countries the share of connections using regulated access products is high, but "inter-platform" share is low.

Figure 4. Share of wholesale access products vs. infrastructure-based connections in the EU



In CEE countries we observe a high degree of inter-platform competition where entrants using their own (non-cable) infrastructure have a high share of broadband connections, see **Figure 4** above. In Bulgaria, Czech Republic, Estonia, Lithuania, Latvia, Poland, Romania and Slovakia the share of broadband connections supplied by entrants using their own infrastructure is above 20%, yet none of these countries have ever had a notable share of ULL.

The observations in this section have shown that there is no evidence up to now that the LoI of investment describes competition in broadband markets in CEE countries.

Below, we discuss potential reasons behind different evolution of broadband markets in WE and CEE countries. We then present results of the econometric analysis that we used to test for the partial and full LoI in the CEE region, which complements the graphical analysis presented above

3.2 Differences between CEE and WE countries

As indicated above competition has evolved differently in CEE and WE countries. There are three key differences in external factors between CEE and WE countries which could explain why competition in telecoms networks would develop differently.[28]

First, the relative costs of rolling-out access infrastructure were significantly lower in CEE compared to WE countries. This is for a number of reasons. The cost of labour, the major part of the cost of network roll-out, is lower in CEE region. For instance, the average monthly minimum wage in CEE countries, which is likely to be a good proxy of the cost of low-skilled labour, is significantly below WE levels[29]. Additionally, there are other region- and country-specific factors that decrease the cost of investing in own access network infrastructure.

For instance, a high concentration of multi-dwelling buildings in towns and cities in CEE countries has likely led to lower relative costs of network rollout. Furthermore, new entrants in CEE countries may have had the option of using several low-cost methods to develop alternative networks which were not available or less available in WE countries. These include using unlicensed WiFi frequencies, co-laying fibre in trenches dug for other purposes by local government, or relying on aerial cabling[30].

Second, entry via incumbent legacy access networks seems to have been less attractive for the alternative operators in CEE countries, compared to WE countries. By the time new member states entered the EU in 2004, the average

---

28 In addition, it is possible that regulatory policies differed in the two regions. To assess comprehensively whether this was the case would be a very significant task and is beyond the scope of this paper.

29 Based on the information from Eurostat (earn_mw_cur) the average monthly minimum wage in CEE countries in 2004 was around EUR 180, which was only 20% of the average monthly minimum wage in WE countries of around EUR 960 (average covers only those countries for which information is available).

30 For instance, cable operator UPC Slovakia launched a legal challenge against Romania based competitor Digi Slovakia for installing overhead cables to deliver triple-play services in the Slovakian capital, Bratislava

fixed voice penetration in CEE, measured as a share of inhabitants with an active access to PSTN network, was only 30.6% compared to 51.3% in WE[31]. The low penetration levels in CEE implied that the potential customer base reachable through incumbent's network was substantially lower than in WE countries. This may have limited the ability of entrants to compete using DSL-based technology compared to rolling out their own access infrastructure.

Another potential explanation for a relative lack of take up of legacy access products by entrants could be that the legacy access networks of CEE incumbents may have been of lower quality and coverage compared to their WE counterparts. The relatively poor quality and coverage of the networks was partly a result of past underinvestment into the telecoms infrastructure in some CEE countries. As a result, the ability of CEE incumbents to deliver reasonably quality DSL broadband services using its legacy access network may have been limited in comparison to WE countries[32].

Third, by the time new member states accessed the EU in 2004 and CEE incumbents began offering regulated access to their legacy wholesale products, there were already signs of increasing consumer demand for higher speed broadband products. For example many local providers had already started rolling-out their fibre networks in some CEE countries. Therefore, by the time ULL became effectively available in CEE countries, new entrants were facing increased risk that any investment into equipment needed to provide services using ULL may not be fully recoverable in the future, if this technology was likely to become obsolete. All these factors are likely to have impacted the preferred mode of entry in CEE countries and can help explain the differences in the competition patterns observed in the CEE region.

3.3 Incorporating differences between CEE and WE countries in the econometric analysis of the LoI hypothesis

The graphical analysis presented in Section 3.1. appears to show that neither the full LoI nor the partial LoI describes the way competition has evolved in CEE countries. To give further support to this finding, in this section we undertake econometric analysis to test for the partial and full LoI. We first explain our approach, before presenting our results.

---

31 Own calculation based on the data from World Bank available at http://data.worldbank.org/

32 These include the length and small diameter of copper cables, the copper pair sharing among multiple end-users and the use of aluminium cables.

Our approach adds to the existing literature by focussing on the evolution of broadband markets in CEE countries. To our knowledge, no existing papers have explicitly analysed the CEE region . Of the most recent studies, Bacache et.al. (2013) focus purely on WE countries, whereas Garrone et.al. (2011) do include CEE countries in their sample, but they do not explicitly control for differences between CEE and WE countries.

We use a bi-annual data set from 2004 to 2011. Most of our data comes from the European Commission, although we have also relied on other sources for soci-economic data, such as Eurostat. Further details of the data used is contained in an annexe.

As with Bacache et.al.'s (2013) approach, we assess the full LoI by looking at the impact of lagged values of ULL take up[33] on new lines provided by alternative infrastructure. If the full LoI has worked in CEE, then lagged ULL should have a positive impact on new lines, as new entrants move up the ladder. Similarly, for the partial LoI, we consider whether lagged values of bitstream impact on the take up of ULL. In this case, lagged bitstream should have a positive influence on ULL if the partial LoI has been successful.

A key question is how many lags of ULL (for the full LoI model) and bitstream (for the partial LoI model) to include in the model. Building a telecoms network takes time, which points towards the need to include multiple lags. However, this would result in a model with a lot of explanatory variables given that each of the lags need to be interacted with the CEE dummy. This can be problematic as it can be difficult to disentangle the impact of individual lags. To circumvent this problem, we have calculated the average lag of ULL and the average lag of bitstream. In our model, we take the average lag over the past two time periods, which is equivalent to a year since our data is bi-annual.[34] As a robustness check, we also take the average lag over the past four time periods (i.e. two years) to ensure that we are fully capturing any potential LoI.

We control for a range of demand side and supply side drivers. On the demand side, we control for GDP per capita, household numbers and fixed line penetration. On the supply side, we include population density in our model. We also control for a linear time trend since telecoms networks are likely to develop over time, independent of any of the other explanatory variables.

We have taken the natural log of all of our variables, except for the ones that are measured as a ratio, which relates to population density and fixed line

---

33 Below we refer to ULL take up simply as ULL and bitstream take up as bitstream.

34 For example, for ULL we have calculated the average lag as (first lag of ln(ULL) + second lag of ln(ULL))/2

penetration.[35] Taking logs more accurately reflects the relationship between the variables, and reduces the impact of outliers. It is also in line with Bacache's et.al. (2013) approach.

We estimate the model using Ordinary Least Squares (OLS) with robust standard errors. Unlike Bacache et.al. (2013), we do not include a lagged dependent variable in our model, so we do not use a GMM estimator. We have also presented results when using a fixed effects estimator.[36]

The equation below shows how we have estimated the partial LoI.

$$\ln(ULL_{it}) = Constant + \ln(AvLagBit) + \ln(GDP\ pc_{it}) + density_{it} + fixed\ penetration_{it} + \ln(householdnumbers)_{it} + time\ trend + \varepsilon_{it}$$

The equation that we used for estimating the full LoI is similar, as shown below.

$$\ln(NL_{it}) = Constant + \ln(AvLagULL) + \ln(GDP\ pc_{it}) + density_{it} + fixed\ penetration_{it} + \ln(householdnumbers)_{it} + time\ trend + \varepsilon_{it}$$

Our key result is that there is no evidence of a partial or full LoI in CEE countries. This is not surprising given the charts presented in Section 3.1.

In the table below, we show the results for the partial LoI. In regression 1, we have used the average bitstream lag over 2 time periods (1 year), whereas in regression 2 we have used the average bitstream lag over 4 time periods (2 years).

Regressions 3 and 4 use the same specifications, but are estimated using fixed effects, rather than OLS. The success of the partial LoI in CEE is determined by the co-efficient on the lag of bitstream . As the co-efficient is insignificant across all of our regressions, our analysis shows that there is a lack of evidence that the partial LoI has worked in CEE countries[37]. In other words, it does not appear that new entrants have used bitstream as a stepping stone to ULL in CEE countries.

---

35 See annexe for a more detailed description of the variables. We have added a 1 to all of the variables where we have taken logs, since you cannot take the log of zero.

36 However, we note that a fixed effects estimator only uses variation across time, which can render many of the co-efficients insignificant.

37 The co-efficient on bitstream is also insignificant when using random effects. We have presented the results from the fixed effects regression rather than the random effects regression because a Hausman test showed that the difference between the co-efficients in the fixed effects and random effects models are statistically different at a 1% level of significance. Under such circumstances, it is appropriate to use a fixed effects estimator, as it will provide unbiased results although it is less efficient than a random effects estimator.

	OLS	OLS	Fixed Effects	Fixed Effects
	(1)	(2)	(3)	(4)
VARIABLES	ULL share of lines (%)	ULL share of lines (%)	ULL share of lines (%)	ULL share of lines (%)
Bitstream lagged by 1 year	**0.0653**		**0.427**	
	(0.0507)		(0.533)	
Bitstream lagged by 2 years		**0.0812**		**0.530**
		(0.0608)		(0.600)
Population Density	0.000486***	0.000388**	0.0131**	0.0141*
	(0.000159)	(0.000170)	(0.00507)	(0.00705)
Log GDP per capita	0.0336***	0.0551***	-0.0500*	-0.0445
	(0.0115)	(0.0153)	(0.0263)	(0.0301)
Log household numbers	-0.0189***	-0.0146**	0.121*	0.0993
	(0.00606)	(0.00647)	(0.0592)	(0.0819)
Linear time trend	0.00426***	0.00472***	0.00198*	0.00150
	(0.000959)	(0.00122)	(0.000949)	(0.00109)
Wireline penetration	-0.00360	0.00842	-0.0790	-0.0534
	(0.0170)	(0.0186)	(0.0855)	(0.0796)
Constant	-0.225*	-0.463***	-1.547**	-1.541*
	(0.118)	(0.158)	(0.588)	(0.758)
Observations	118	96	118	96
R-squared	0.504	0.570	0.566	0.491
Number of countries			11	11

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As shown by the table below, there is also a lack of evidence that the full LoI has worked in CEE countries. In regression 5, we have used the average ULL lag over 2 time periods (1 year), whereas in regression 6 we have used the average ULL lag over 4 time periods (2 years). In regressions 7 and 8, we have used the same specifications, but we have used fixed effects rather than OLS. In none of our specifications do we a positive and significant coefficient on ULL[38]. This means that there is a lack of support for the view that new entrants have used ULL as a stepping stone for building alternative infrastructures in CEE countries.

	OLS	OLS	Fixed Effects	Fixed Effects
	(5)	(6)	(7)	(8)
VARIABLES	Share of new lines	Share of new lines	Share of new lines	Share of new lines
ULL lagged by 1 year	**-0.590*** **		**0.133**	
	(0.207)		(0.318)	
ULL lagged by 2 years		**-0.643*** **		**0.196**
		(0.239)		(0.360)
Population Density	0.000480	0.00115	-0.0127	-0.0187**
	(0.000820)	(0.000745)	(0.00725)	(0.00830)
Log GDP per capita	-0.289***	-0.322***	0.135	0.0920
	(0.0646)	(0.0666)	(0.110)	(0.0903)
Log household numbers	-0.0631**	-0.0939***	-0.0439	0.168
	(0.0317)	(0.0286)	(0.263)	(0.269)
Linear time trend	0.0176***	0.0157***	0.00507	0.00573
	(0.00329)	(0.00398)	(0.00294)	(0.00333)
Wireline penetration	-0.147***	-0.210***	-0.0658	-0.0672
	(0.0489)	(0.0470)	(0.0610)	(0.0415)
Constant	3.294***	3.845***	0.463	-0.196
	(0.732)	(0.724)	(1.561)	(1.694)
Observations	134	112	134	112
R-squared	0.553	0.579	0.336	0.305
Number of countries			11	11

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

38 The co-efficient on ULL is also insignificant when using random effects.

As well as varying the length of the lag and using fixed effects, we have also carried out several other robustness checks to ensure that our results for the partial and full LoI hold under different approaches. We tried using ULL prices, since they may have an impact on both the uptake of ULL and new lines. Bacache et.al. (2013) also included ULL lines as a sensitivity check. In addition, we extended our sample to include WE countries, while including different dummy variables for CEE countries to allow the intercept, and the slope respectively, to vary for these countries.[39] We also tried to control for the fact that the correlation between lagged Bitstream and ULL might differ based on the phase of market development.[40] Finally, we included broadband accesses based on cable technology in our definition of 'new lines'. We also tried using clustered standard errors. Under all of our robustness checks, our key result is that there is no evidence of a partial or full LoI in CEE countries.

While we have carried out many robustness checks, we acknowledge that there are several challenges when trying to test the partial and full LoI, particularly when trying to account for differences across regions. For example, there is considerable heterogeneity in the speed at which broadband competition has developed in individual countries, as shown by the graphs in the annexe. It's difficult to fully account for this heterogeneity in regression models. Despite the challenges present, our analysis adds to the literature by showing that there is a lack of evidence that the partial or full LoI describes the way competition has evolved in CEE countries.

---

39 Under a full sample of WE and CEE countries, the F-test results suggest that there is statistically significant differences between coefficients for WE and CEE countries, implying a separate regressions are more appropriate.

40 Under partial LoI one would expect Bitstream to increase in the early years and then start declining as people climb the ladder and switch to ULL. Therefore, there might be a positive or negative correlation between lagged Bitstream variable and ULL variable, depending on in which phase each country in our sample was in the period captured by our analysis, i.e. 2004-2011. This makes it difficult to estimate the true relationship between the two variables using a linear estimator approach. To control for this potential effect, we include a dummy variable indicating when Bitstream reached its peak in a given country, i.e. after which year we would expect a negative correlation between lagged Bitstream and ULL variable.

4 Conclusions

The empirical literature to date tends to find some evidence of the entrants "climbing" lower rungs of the LoI to date but raise doubt on whether the entrants' use of the incumbent operator's wholesale access products leads to greater inter-platform competition.

Our paper adds to the literature by focusing on whether there is evidence for a LoI in CEE countries. This builds on the existing studies, which focus just on Western Europe or consider the whole of the EU without accounting for any specifics of the CEE region. Our analysis of the development of different forms of broadband based competition suggests that entrants in CEE countries have managed to by-pass the LoI by moving straight to inter-platform competition.

Our paper is consistent with the view that the LoI is an approach that may partially explain entry and expansion in some countries. It seems likely that these countries have specific characteristics such as: where access based regulation was widely implemented by the early half of the 2000s; where the legacy access network is ubiquitous, high quality, and penetration of fixed line services was high; and where costs of building own access networks are high. However, these conditions are not universal and in particular may not apply to CEE countries.

5 Literature overview

Bacache, Maya, Bourreau, Marc and Gaudin, Germain (2013): "Dynamic Entry and Investment in New Infrastructures: Empirical Evidence from the Telecoms Industry" Telecom ParisTech

Bourreau, M., Dogn, P. and M. Manant (2010) "A critical review of the "LoI" approach", Telecommunications Policy, vol. 34, pp 683-696

Briglauer, W. G. Ecker and K. Gugler (2011): "Regulation and Investment in Next Generation Access Networks: Recent Evidence from the European Member States", working paper available at. http://epub.wu.ac.at/3291/

Cave, M. and Vogelsang, I. (2003), "How Access Pricing and Entry Interact", Telecommunications Policy 27, pp. 717-727.

Cave, M. (2006), "Ecouraging infrastructure investment via the ladder of investment", Telecommunications Policy 30, pp. 223-237.

Crandall, R. W., Ingraham, A. T. and Singer, H. J. (2004), Do Unbundling Policies Discourage CLEC Facilities-Based Investment?" Topics in Economic Analysis and Policy, 4(1), article 14.

European Commission decision of 22 June 2011 relating Case COMP/39.525 – Telekomunikacija Polska

European Commission decision of 4 July 2007 relating Case COMP/38.784 – Wanadoo España vs. Telefónica

European Regulators Group - ERG (03) 30rev1 ERG Common Position on the approach to Appropriate remedies in the new regulatory framework

Friederiszick, H., M. Grajek and L.-H. Roller (2008): "Analyzing the Relationship between Regulation and Investment in the Telecom Sector", March 2008.

Grajek, M and L. –H. Roller (2009): "Regulation and Investment in Network Industries: Evidence from European Telecoms", Working Paper, ESMT No.09-004.

Hausman, J. and G. Sidak (2005): "Did mandatory unbundling achieve its purpose? Empirical evidence from five countries" Journal of Competition Law and Economics, 1(1), 173-245.

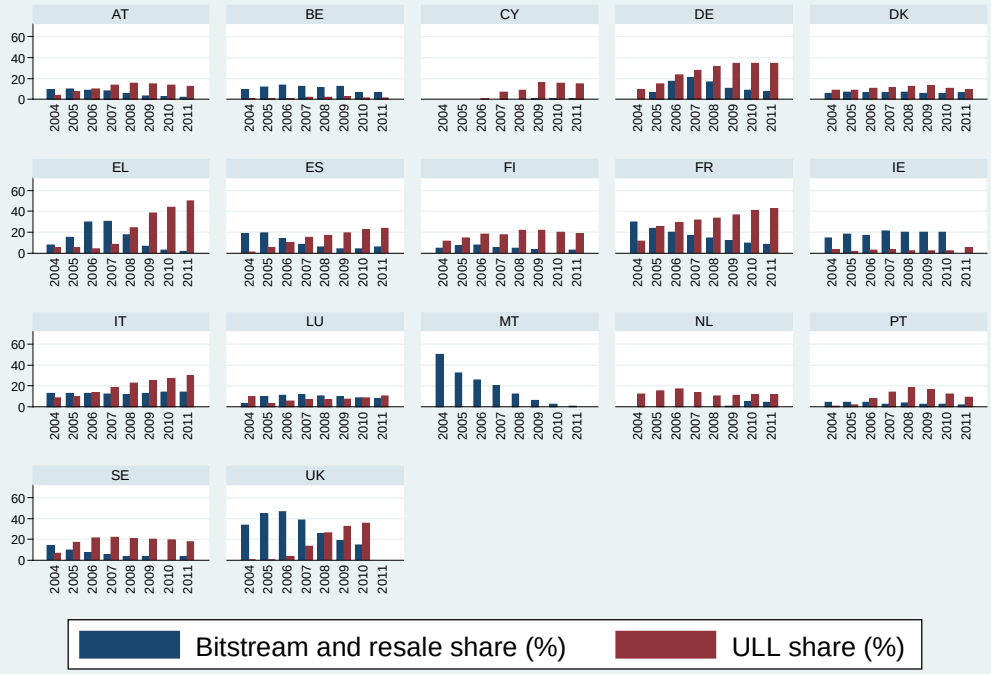
P. Garrone and M. Zaccagnino (2011): "The relationship between local loop unbundling and the deployment of alternative broadband networks. An empirical analysis", working paper.

Stehman, O. and R. Borthwick (1994) "Infrastructure competition and the European Union's telecommunications policy" Telecommunications Policy 18, pp. 601-615.

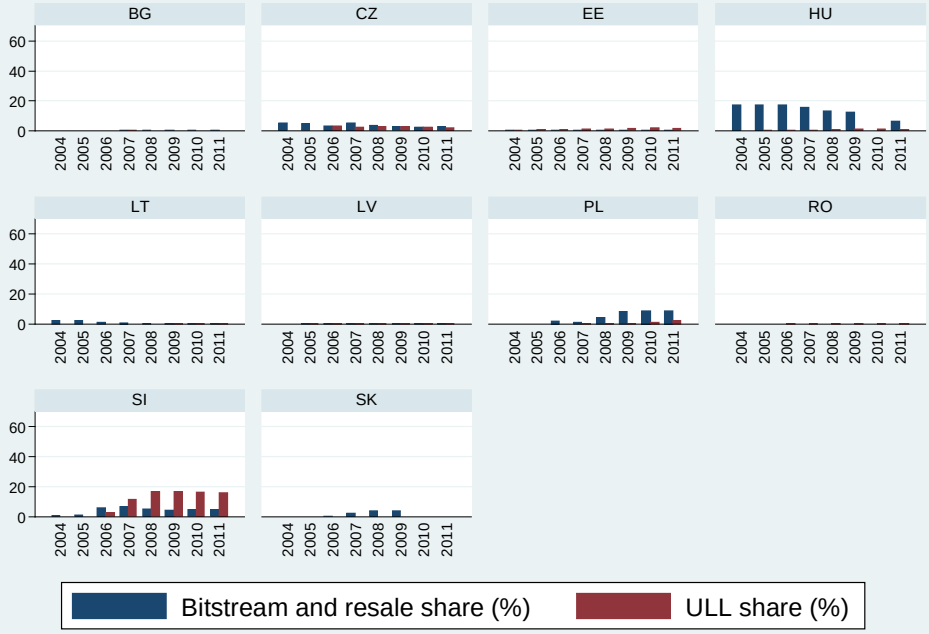
Wallsten, S. and S. Hausladen (2009): "Net Neutrality, Unbundling, and their Effects on International Investment in Next-Generation Networks", *Review of Network Economics*, Vol.8, Issue 1 – March 2009.

.

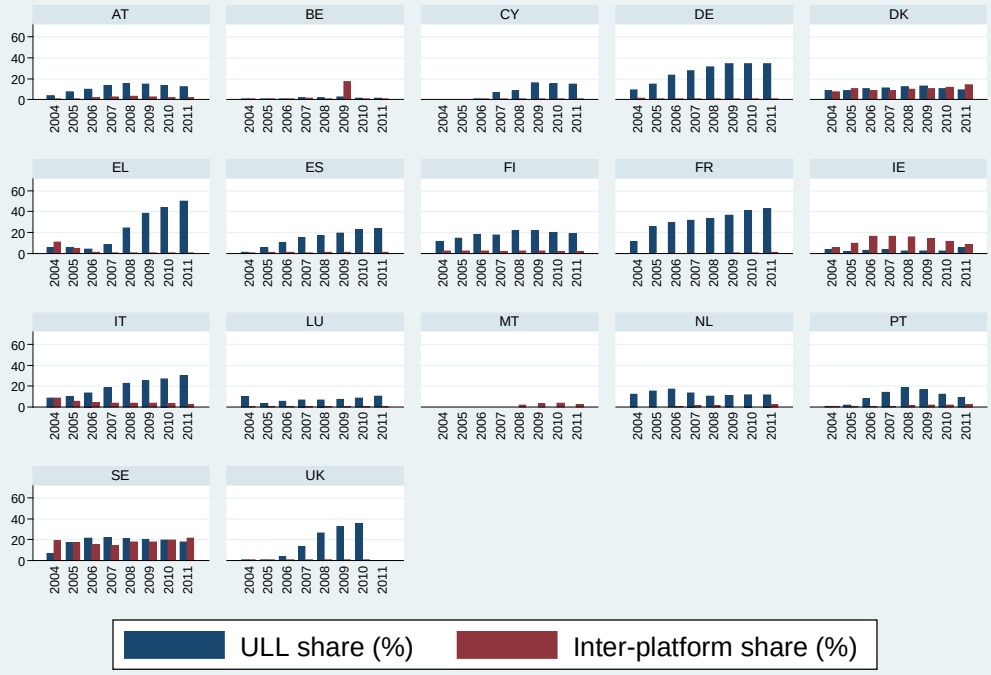
6 Annex



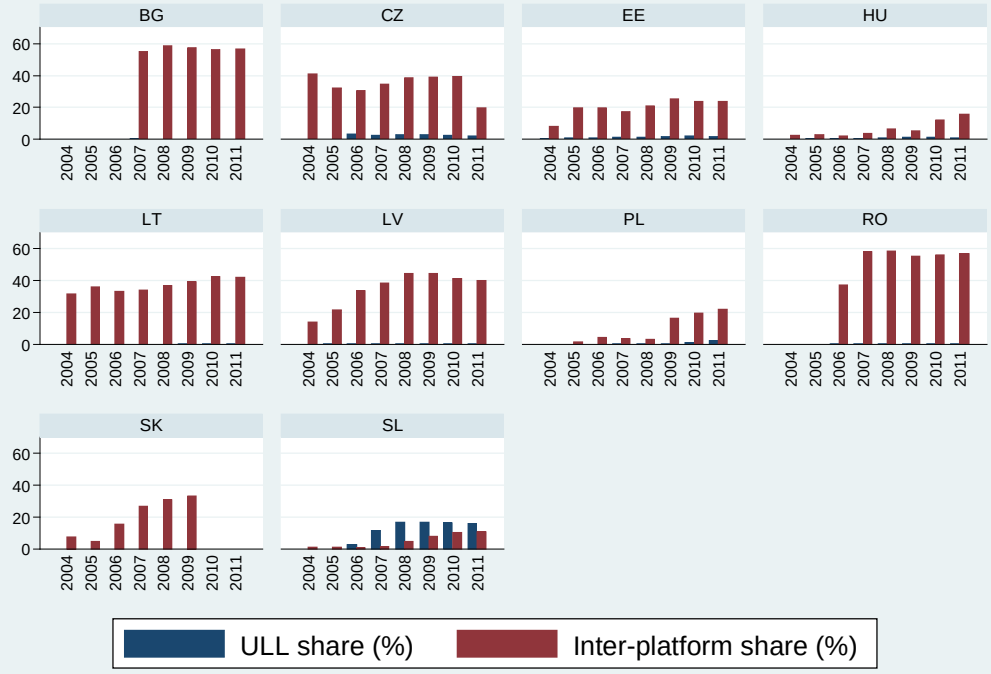
Graphs by Country



Graphs by Country



Graphs by Country



Graphs by Country

Table 1. Descriptive statistics (CEE countries)

Variable	Observations	Mean	Standard deviation	Min	Max
Share of new lines	175	22%	20%	0%	61%
ULL share	175	2%	5%	0%	17%
Bitstream share	155	4%	7%	0%	50%
Population density	192	189	332	32	1,300
GDP per capita	188	10,576	4,694	2,600	21,800
Household numbers (000s)	192	3,082	3,648	125	13,596
Time	192	9	5	1	16
Fixed line penetration	176	81%	39%	46%	210%

Table 2. Variables used for econometric analysis

Variable	Description	Source
$\ln(ULL_{it})$	The natural log of full ULL and shared ULL lines in country i at time t.	European Commission
$\ln(NL_{it})$	The natural log of new lines (excluding cable) in country i at time t	European Commission

$\ln(AvLagULL) +$	The average of lagged ULL lines (over either 2 periods or 4 periods) e.g. $(\ln(ULL_{it-1}) + \ln(ULL_{it-2}))/2$	European Commission
$\ln(AvLagBit) +$	The average of lagged bitstream plus resale lines (over either 2 periods or 4 periods) e.g. $(\ln(Bit_{it-1}) + \ln(Bit_{it-2}))/2$	European Commission
$\ln(GDP\ pc_{it})$	The natural log of GDP per capita in country i at time t.	Eurostat
$density_{it}$	The population density in country i at time t.	United Nations
$wirelinepenetration_{it}$	The fixed line penetration rate in country i at time t.	Telegeography
$\ln(householdnumbers)_{it}$	The natural log of the number of households in country i at time t.	Eurostat
ε_{it}	Error term in country i at time t.	

IES Working Paper Series

2014

1. Diana Zigraiova, Petr Jakubik: *Systemic Event Prediction by Early Warning System*
2. Pavla Blahova, Karel Janda, Ladislav Kristoufek: *The Perspectives for Genetically Modified Cellulosic Ethanol in the Czech Republic*
3. Oxana Babecká Kucharčuková: *The impact of exchange rate volatility on trade: Evidence for the Czech Republic*
4. Oliver Polyák: *The Impact of Euro Adoption on Export Performance: Comparison of the Czech Republic and Slovakia*
5. Lucie Davidová, Vladimír Benáček: *Determinants of Austrian International Trade: Analysis Based on the Gravity Model*
6. Julie Chytilová, Václav Korbel: *Individual and Group Cheating Behavior: A Field Experiment with Adolescents*
7. Petr Janský: *Consumer Demand System Estimation and Value Added Tax Reforms in the Czech Republic*
8. Pavel Hait, Petr Janský: *Inflation Differentials among Czech Households*
9. Hana Džmuráňová, Petr Teplý: *Risk management of savings accounts*
10. Tomáš Fiala, Tomáš Havránek: *Ailing Mothers, Healthy Daughters? Contagion in the Central European Banking Sector*
11. Andrlíková Petra: *Is Barrier version of Merton model more realistic? Evidence from Europe.*
12. Martin Pospíšil, Jiří Schwarz: *Bankruptcy, Investment, and Financial Constraints: Evidence from a Post-Transition Economy*
13. Matt Hunt, Goran Serdarević, Tom Ovington, Clive Kenny: *Evidence for a ladder of investment in Central and Eastern European countries*

All papers can be downloaded at: http://ies.fsv.cuni.cz

Univerzita Karlova v Praze, Fakulta sociálních věd
Institut ekonomických studií [UK FSV – IES] Praha 1, Opletalova 26
E-mail : ies@fsv.cuni.cz

http://ies.fsv.cuni.cz