# Charles University in Prague

**Faculty of Social Sciences**

**Institute of Economic Studies**

**DISSERTATION**

# The Efficiency of Economic Regulation in the European Union

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## Bibliographic Record

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# Abstract

This dissertation deals with the topic of economic regulation, focusing on applying empirical methods to assess the efficiency of regulatory measures used in different areas of the EU economy. It consists of three parts, the first part looks at the functioning of the EU merger control, the second and third focus on the relationship between regulation, competition and investment in telecommunications markets.

The first chapter deals with the EU competition policy and the specific area of merger control, analysing empirically the impact of introducing more economic approach in evaluating competition effects of mergers at the EU level. Our key finding is that the regulatory reform introduced in 2004 has, to some extent, enhanced the efficiency of European merger control. This implies that the Commission's assessments of mergers under the new regulation post the 2004 reform are more consistent with the independent market evaluations. We find that the probability of an anti-competitive deal being cleared decreases significantly under the new regulatory framework. Nevertheless, the occurrence of unnecessary remedies imposed on pro-competitive mergers has not decreased as the result of the new merger control. Overall, our results indicate that more economic approach applied post 2004 reform increased the efficiency of merger control regulation and led to better outcomes for EU consumers.

The second chapter explores the regulatory model applied to promote market entry and competition in the markets for fixed telecommunications services. The chapter focuses on the market for broadband internet, the application of so called 'Ladder of Investment' (LoI) principle in regulation of these markets, and looks at the outcomes of this approach in the new EU member states of Central Eastern Europe (CEE countries). We find that the the LoI regime has not proved to be an efficient form of regulation in the CEE markets, as telecommunications entrants largely chose to by-pass the LoI, by directly investing in their own networks. The implication of this result is that policy makers and regulators should not consider the LoI a universally applicable theory which explains the evolution of competition in all broadband markets. Rather its applicability depends on several country specific factors which were not present to the same degree in CEE counties compared with Western Europe.

The third chapter looks at the specific situation of mobile service industry. This sector developed through market forces and with relatively less regulatory control, compared to fixed telecommunications. The prevailing model of competition is so called network-based competition where multiple operators compete relying on their own network infrastructure. Recently, there has been increasing debate whether this model is efficient and sustainable going forward. In particular, we consider whether mobile markets would benefit from removing network duplication by creating single wholesale networks (SWNs) and moving towards more 'service-based' competition. Our main finding based on empirical evidence is that mobile network competition has delivered superior outcomes to single networks in terms of higher coverage, take-up and innovation. Therefore, there are significant risks of regulatory inefficiency from moving away from the network competition model into the world of single wholesale networks. Our results suggest that there could be considerable

consumer harm, which may be difficult to reverse, and cost and benefits of particular SWN proposal should therefore considered carefully by policy makers.

# Contents

# Introduction

The liberalisation and privatisation of major network industries in Western economies post 1980 created a new paradigm in which effective and efficient regulatory regimes were required to deliver positive outcomes for consumers. In Europe many former state-owned monopolies became privately owned. New rules and regulations had to be introduced preventing these dominant players from abusing their position in the market at the expense of end-users, while incentivising sufficient investment and innovation. It is an inherently challenging task of finding the right balance between securing low prices for consumers that encourage consumption and ensuring sufficient profits for shareholders to promote further investment in the infrastructure, essential for the long term development of these network industries; such as energy or telecoms (Kunneke et al 2010; Newbery 2002; Vickers and Yarrow 1990).

This shift in the socio-economic paradigm was accompanied by an increasing application of economics in developing policy and regulatory frameworks. Key findings of economic theory were used to create regulatory mechanisms to generate outcomes as close as possible to what consumers would experience in the ideal world of perfect competition (i.e. where prices are set to reflect marginal cost and social welfare is maximised as a result). This included a combination of different forms of regulation, from direct price/return controls in natural monopoly markets (where single firm production was still the most efficient) to introducing competition through access regulation in parts of the market that became effectively contestable, often as a result of rapid technological progress in these industries over the last two decades. Economics therefore played ever increasing role in creating and enforcing the 'rules of the game' across the EU economy, but most significantly within network industries (Bauer 2014; Cowhey and Aronson 2009; Coen and Doyle 1999).

Many of these regulated markets are large and complex by nature, with multiple stakeholders and various interest groups trying to progress their own agendas and objectives. Therefore, evaluating how successful various regulatory frameworks have been over time is a challenging task. Nevertheless, economics offer an empirical toolkit that can be applied to shed some light even into highly complex questions, as long as these questions are appropriately defined and there is enough data to test these questions empirically.

At the same time, it is important to recognise the limitations of any empirical approach, as we inevitably tend to work with models simplifying reality and the ability to answer even narrowly defined set of questions will strongly depend on the quality of the underlying data. This thesis is therefore not trying to universally assess the quality of regulation in the EU. We rather focus on selected areas where economic regulation has been increasingly applied, such as the merger control, and use data driven techniques to test the 'true' effects of these regulatory approaches on market outcomes for consumers. We then use these empirical results to try to come up with tangible policy recommendations on how to further improve regulation in these specific segments of the Single European market.

There are three broad questions that this thesis tries to answer using empirical approach:

1. Has the more economic approach to merger control led to better competitive outcomes for EU consumers?

2. Has the regulatory model for promoting competition and entry in broadband internet markets actually worked in the new EU member states?

3. Is there a strong economic case for introducing single wholesale networks and more access regulation in mobile markets?

We attempt to answer these research questions in three papers presented in this thesis. Each paper focuses on a relatively diverse topic and works with different empirical approaches, but there are two common themes that run throughout the thesis.

First, the thesis focuses on the impacts of applying economic regulation in highly concentrated markets, where the effectiveness and efficiency of regulation will have a major effect on the market outcomes for consumers.

- For instance, the EU merger control is typically applied on large transactions in markets characterised by high levels of concentration, where it is essential to find the right balance between protecting consumers and allowing companies to discover healthy growth opportunities. Understanding how successful the EU competition authorities were in achieving this balance is the main theme of the first part of this thesis.

- Similarly, fixed telecommunication markets in the EU are characterised by high entry barriers and strong economies of scale in different parts of the supply chain. At the same time, some of these markets are undergoing significant technological changes with the rise of alternative technologies, such as fibre optics in telecommunications. This creates additional challenges for regulators in finding the right balance between promoting competition and long term investment. The second paper focuses on the impact of regulation on the entry and competition in fixed broadband markets in new EU member states from Central and Eastern Europe (CEE).

- Finally, mobile markets in the EU have evolved in a very different way to fixed markets and are characterised by market entry of large scale national players and competition between multiple networks. At the same time, the recent trend in the EU and elsewhere towards more network sharing and consolidation raises questions around the sustainability of the network competition model in the long run. This implies that policy makers and regulators will need to carefully consider trade-offs between promoting more rationalised cost structure of the mobile industry and protecting intensive network competition that led to significant consumer benefits over the last three decades. The third paper and the final part of the thesis considers the impact of the prevailing regulatory model in mobile industry (i.e. network competition) on key market outcomes such as mobile coverage and take-up.

Second, the thesis works with unique datasets to empirically address the key research questions defined above.

- For the first paper, we constructed a unique sample of 161 horizontal mergers evaluated by the European Commission between 1990 and 2008. For each merger, we reviewed the case documentation and manually extracted the relevant information about the market characteristics, key competitors and the specifics of Commission's decisions. We also collected stock market data for the merging parties and key competitors around the time of the merger announcement. Overall, this time consuming process resulted in a dataset allowing us to gain the first insight into the effects of the EU merger control reform in 2004, as none of the earlier studies worked with merger cases evaluated after 2002.

- For the second paper, we collected relevant data on different forms of broadband market entry across all EU states in the period of 2004 – 2011 from the bi-annual publications of the Commission.[1] This again required a substantial manual work extracting the relevant data from documents published over a relatively long period and ensuring a consistency of the data used. We then combined this dataset with additional socio-economic measures (e.g. income levels, population density) from other sources, creating a unique dataset suitable for an econometric testing of market outcomes in the CEE countries.

- In the third paper, we work with an extensive dataset provided by the GSM Association (GSMA), which covers information about key characteristics of mobile markets from all around the world.[2] We rely on this dataset to measure the performance of mobile markets in 205 countries over the period of 2001 to 2012.[3] To our best knowledge, this is the most comprehensive empirical assessment of the impact of network competition on mobile coverage, one of the key outcomes for consumers in the markets for mobile communication services.

We discuss main findings and contributions of each of the three papers in more detail below.

**The Efficiency of EU Merger Control during the Period 1990 – 2008**

The main goal of the first paper is to empirically test the functioning of European merger control in light of the 2004 regulatory reform, which was expected to introduce a more efficient regulatory framework for the assessment of mergers within the EU.

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1 http://ec.europa.eu/competition/mergers/cases/

2 https://gsmaintelligence.com/about/

3 Nevertheless, our econometric analysis has to be cross-section approach in 2001 and 2012, as the missing data and inconsistency did not allow for a panel approach across the whole period 2001 - 2012

The core of the 2004 reform was a new legal test based on Significant Impedance of Effective Competition criterion and the newly published Horizontal Merger Guidelines (HMR)[4] which were in line with the modern economic theory of industrial organization and should provide more transparency on how the Commission would assess horizontal mergers. Among other things, the HMR explicitly differentiates between coordinated and non-coordinated effects, thus closing the existing enforcement gap in cases of oligopoly markets where mergers would have anti-competitive effects without creating or fostering dominance. The Guidelines also explicitly list the potential countervailing factors that can result in merger approval despite the market dominance of merging parties, thus giving merger parties more scope for defense against potential rejections from the Commission.[5]

In our research, we use stock market data to try to identify merger cases where there are discrepancies between the Commission's decisions and market evaluations of the mergers in question.[6] The discrepancies are defined as outcomes in which the Commission either:

- blocked a merger which markets perceived as pro-competitive (or imposed unnecessary remedies on such pro-competitive transactions); or
- approved a merger which markets perceived as anti-competitive.

Using the PROBIT model, these merger cases are further investigated to discover the sources of these discrepancies, controlling for various institutional- and merger-specific factors. For instance, we test whether the type of industry in which merger took place has any impact on the probability of discrepancies in the Commission's decision making. Most importantly, we test whether the 2004 reform had any significant effect on the quality of the Commission's decisions, in terms of the occurrence of discrepancies.

*Key findings*

In line with previous studies, our results suggest that the discrepancies are caused by procedural and institutional factors. We also find that the regulatory reform introduced in 2004 has, to some extent, enhanced the efficiency of European merger control. This implies that the Commission's assessments of mergers under the new regulation are more consistent with the market evaluations. We find that the probability of an anti-competitive deal being cleared decreases significantly under the new regulatory framework. Nevertheless, the occurrence of unnecessary remedies imposed on pro-competitive mergers has not decreased as a result of the new merger control system.

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4 Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings (2004/C 31/03).

5 For more details on the desirability of an efficiency defense in merger control, see Lagerlöf and Heidhues (2005).

6 The main advantage of this approach is that we have an independent assessment of the merger's competitive effects which we can compare with the Commission's decisions. Moreover, we observe stock market reactions on the day of the announcement irrespective of whether the merger is approved by the Commission in the end. We thus avoid the censoring problem, as we can include in our sample cases where the merger was blocked by the Commission.

*Main contribution*

To our best knowledge, this paper is the first study using stock market data to evaluate the 2004 reform of the European merger control.[7] We have developed a unique dataset of 161 EU merger cases covering the period from 1990 to 2008, collecting detailed information about the merger from the Commission's case file, identifying merging parties and key competitors and collecting the corresponding stock market data. This data set is then used to identify discrepancies and run econometric analysis to test the true effect of the 2004 reform on the efficiency of the EU merger control. In contrast to previous studies, we apply the original method designed by Bartus (2005) to estimate the average marginal effect of relevant variables in our PROBIT model, considering this to be a more appropriate approach for large data sets of binary control variables.

*Publications and presentations*

The paper was presented and discussed at Economics and Law in Banking and Finance (ELBF) seminar at the Institute of Economic Studies (IES) and at 6th Biannual Conference of the Czech Economic Society. It was published in the IES Working Paper series (vol. 28/2009) and subsequently in the impacted periodical Czech Journal of Finance and Economics (vol. 3/2011)[8]. The extended version of the paper has also been published as a book by VDM Verlag in 2010.

**Evidence for a Ladder of Investment in Central and Eastern European Countries**

The approach to liberalising European telecommunications markets followed in many areas what has become known as the "Ladder of Investment" (LoI) approach. Under this model, regulation is designed to enable entrants 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 where operators rely primarily on their own network infrastructure to compete for end-user.

However, it is unclear from a theoretical perspective whether the LoI approach will necessarily lead to inter-platform competition. Whether and under what circumstances it would is thus an empirical question. There is rich literature which has empirically estimated the degree to which LoI describes the evolution of competition in broadband internet markets in Western European (WE) countries, but there is limited research to date that would focus on new EU member states in Central and Eastern European (CEE) countries.

The main goal of this paper is to empirically test whether the LoI explains the development of broadband markets in CEE countries.

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7 For more recent empirical study of this topic, please see Duso et al. (2013)

8 Serdarević G. and P. Teplý (2011): he Efficiency of EU Merger Control During the Period 1990–2008, Czech Journal of Economics and Finance (Finance a uver), 2011, vol. 61, issue 3, pages 252-276 (available at http://econpapers.repec.org/article/faufauart/v_3a61_3ay_3a2011_3ai_3a3_3ap_3a252-276.htm)

*Key findings*

Our analysis finds that the telecommunications entrants in CEE countries largely chose to by-pass the LoI, by directly investing in their own networks. There are good reasons for this, as some of the key assumptions which underpin the LoI theory do not necessarily hold in CEE countries. This includes good quality and universally available copper networks of an incumbent operator, or the relatively high cost and risk of investing in alternative infrastructure.

The implication of this result is that the LoI should not be considered a universally applicable theory which explains the evolution of competition in all broadband markets. Rather its applicability depends on several country specific factors which were not present to the same degree in CEE counties compared with WE countries. Policy makers, regulators and competition authorities therefore need to take this into an account when dealing with the issues of entry, investment and competition in broadband markets across the CEE region.

*Main contribution*

To our best knowledge, this is the first study that empirically tests the existence and of the LoI in the new EU member states. We build on the existing empirical studies to ensure our econometric results are robust, providing a wide range of sensitivity analyses.

We discuss comprehensively country and region specific factors that likely contributed to very different outcomes in broadband markets observable in CEE countries, namely the limited success of service-based competition and relatively high share of infrastructure-based competition. This provides some intuition supporting our econometric findings and offers further insight into functioning of broadband markets in the CEE region.

Finally, we rely on our key findings to give policy recommendations, mainly in the area of competition policy and theory of harm that antitrust agencies can credibly consider when looking at the competition cases in telecommunications markets across CEE.

*Publications and presentations*

The paper was presented and discussed at ELBF seminars at the IES and at 26th European Regional ITS Conference 2015 in Madrid[9]. The first version was published in the IES Working Paper series (vol. 13/2014) and the final revised version has been accepted by the impacted journal Telecommunications Policy and published in the first half of 2016.[10]

**The impact of network competition in the mobile industry**

The growth in mobile telecommunications market in the last three decades has been characterised by a gradual shift towards inter-platform competition, with multiple mobile

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9 http://econpapers.repec.org/paper/zbwitse15/default1.htm

10 Serdarević, G.,et al. (2016): Evidence for a Ladder of Investment in Central and Eastern European countries, Telecommunications Policy, 2016, available online at http://dx.doi.org/10.1016/j.telpol.2016.02.007i

operators competing based on their own wireless network infrastructure. For instance, in 2000 there were as many countries served by a single mobile network as by network competition (i.e. where there are multiple mobile networks). Today, only 30 countries, representing less than 3% of the world's population, are served by a single network.

The mobile markets around the world are becoming mature and more saturated and the scope for further organic growth appears to be more limited. As a result, there has been considerable discussion about the optimal number of network operators in the mobile industry. More recently, some regulators and governments have considered implementing a single wholesale network (SWN) to deliver next generation mobile services (e.g. 4G and 5G). These considerations have often been triggered by specific concerns around low coverage, inefficient duplication of costs and lack of retail competition under the existing network competition regime. In other words, some governments hope to use SWN as an efficient tool to increase social welfare by achieving higher coverage and take-up of next generation mobile services than what current market mechanism is able to deliver, in particular in more rural areas of the country.

To date, we are not aware of such SWNs being fully implemented in the mobile industry.[11] What is clear is that SWN approach represents a U-turn with respect to the way in which the mobile industry has developed worldwide, i.e. reducing the inter-platform competition between different mobile networks and promoting a regulated wholesale access regime to achieve intra-platform competition over one common infrastructure.

What is less clear is the long-term effect that this reduction in inter-platform competition may have on the relevant competitive outcomes if more policy makers decide to follow the SWN route. Therefore, it is important to carefully examine the available evidence on the performance of mobile markets in countries with a single mobile networks, as this is could shed some light on the expected performance of SWNs. While we recognise that single network countries may be an imperfect proxy for a regulated SWN, we consider that historical data evidence can still provide a useful insight into potential effect of moving away from the prevailing network competition model onto key measures such as network coverage and take up.

*Key findings*

The key conclusion is that mobile network competition has delivered superior outcomes to single networks. The empirical evidence on the evolution of mobile markets suggests that network competition leads to higher coverage, take-up and innovation compared to countries served by a single network, all else equal. We find that the availability of mobile services in terms of population coverage was up to 21% higher in countries with network

[11] The most prominent example of SWN efforts appears to be Mexico, where the Government has made constitutional changes to facilitate establishing of a wholesale mobile broadband network and has allocated a substantial share of newly available mobile spectrum in 700 MHz band to this entity https://www.telegeography.com/products/commsupdate/articles/2015/05/28/mexico-slashes-investment-target-for-700mhz-wholesale-network/

competition, overall take-up of mobile services was 12% higher while take-up of 3G mobile services (used as a proxy for market innovation) was approximately 17% higher.

Clearly, the paper does not provide a complete assessment of all determinants of consumer outcomes, as it is challenging to accurately capture all differences in regulatory frameworks and market conditions across countries. However, it does highlight the importance of network competition, and provides a platform for future research into how best to leverage network competition to achieve positive consumer outcomes.

*Main contribution*

This paper represents a significant contribution to this research area, as we are not aware of any other papers that have considered the impact of network competition compared to single networks on market outcomes such as coverage. The paper also works with a unique and comprehensive global dataset covering mobile market outcomes across more than 200 countries.

The results of the paper have significant policy implications, as they imply that moving away from the network competition model into the world of single wholesale networks could cause considerable consumer harm, which may be difficult to reverse, and should therefore considered carefully by policy makers.

*Publications and presentations*

The paper has been presented and discussed at ELBF seminars at the IES and at 26th European Regional ITS Conference 2015 in Madrid[12]. The paper was submitted to the journal Competition and Regulation in Network Industries and we have received comments from two anonymous reviewers. The final revised version has been accepted and published in the second half of 2016. [13]

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12 http://econpapers.repec.org/paper/zbwitse15/default1.htm

13 Houpis G., Rodriguez J.M., Serdarević, G. and Ovington T. (2016): The Impact of Network Competition in the Mobile Industry, Competition and Regulation in Network Industries, 2016, vol. 1, available online at http://www.crninet.com/table_of_content.aspx?sy=2016&pn=1

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# 1. Merger control in the European Union – has the more economic approach led to better regulatory outcomes?

## 1.1. Introduction

European merger control dates back to the Treaty of Rome of 1957, which created the European Economic Community and its main institutions. Although merger control was not explicitly mentioned in the Treaty, the competition rules set out in Article 81 (formerly Article 85) and Article 82 (formerly Article 86) of the Treaty prohibited the abuse of a dominant position and to some extent also dealt with anti-competitive agreements which may have an appreciable effect on trade between Member States and which prevent, restrict or distort competition in the Single Market.

While initially both Articles 81 and 82 might have been applied to mergers only in a limited way, they still allowed some degree of influence by the European Commission over potentially very unattractive mergers (see Lyons, 2008). The Commission did not obtain real merger control authority until 1989, when the main legislative text for merger regulation – the European Community Merger Regulation (ECMR) – appeared. This was viewed as one of many measures necessary to facilitate the development of a single European market (Vickers, 2004).

The ECMR gave the Commission vast power to enforce competition policy in the EU. All planned mergers of large companies that have significant business activities in the Member States have to be submitted for approval by the Commission.[14] The Commission then evaluates the proposed combination in a short proceeding known as a Phase I investigation. If the Commission finds the proposed merger to be generally compatible with the rules of the Common Market, it either approves the merger (Article 6.1. of the ECMR), or approves it with some conditions and obligations (Article 6.1.b). Otherwise, the Commission starts a more detailed Phase II investigation that can again result in the merger being approved (Article 8.1.), being approved with remedies (Article 8.2.) or being blocked (Article 8.3.). If the Commission finds the merger unacceptable and prohibits it, the decision is final unless it is revoked by the Court of First Instance (CFI). The decision of the CFI may come two or three years after the Commission decision and, given the delay, is likely to be irrelevant for the

[14] According to Article 1(2) of the ECMR, a concentration is deemed to have a Community dimension when (i) the combined aggregate worldwide turnover of all the undertakings concerned exceeds EUR 5 billion; and (ii) the Community-wide turnover of each of at least two undertakings concerned exceeds EUR 250 million, unless each of the undertakings concerned achieves more than two-thirds of its aggregate Community-wide turnover within one and the same Member State. For credit and financial institutions the turnover thresholds are replaced by consideration of financial income sources (i.e., interest income, income from securities) while for insurance companies turnover is replaced by gross premium written; see Turnover Calculation Notice, paragraphs 56–57.

companies originally interested in merging.[15] Therefore, the Commission has an enormously strong bargaining position for enforcing various commitments by the merging companies (in comparison with its US and UK counterparts).[16]

In addition, the importance of the Commission is increasing with regard to the number of merger proposals it now evaluates. During the early years of merger control, the Commission yearly evaluated only a few merger cases, while in 2007 the number of cases evaluated exceeded 400.

With the increasing number of cases evaluated, the confidence of the Commission in the adequacy of its decisions has risen too. The number of merger cases charged with some form of remedy rose significantly and the number of prohibited mergers reached its maximum in 2001, when five mergers were blocked. A major shock came, however, in 2002, when the CFI reversed three of those controversial decisions, raising serious concerns about the inadequate economic analysis and procedural weaknesses of the Commission's evaluation methods (Lyons, 2008).[17]

The Court opined that regulations were needed to introduce a "more economic approach" into the Commission's appraisal procedures, a concept already recognized in a Green Paper (2001).[18] The reform process culminated in 2004, when a new ECMR, together with guidelines for the assessment of horizontal mergers, was introduced.

In terms of the procedural and institutional changes, the new framework preserves the so-called "one-stop shop"[19] rule, but it also makes it easier for national authorities to take part in the decision-making process in merger cases that significantly affect competition within their member states. It also gives the Commission more time to cope with the increasing workload: new pre-notification rules have been put in place and both the Phase I and Phase II investigation durations have been extended moderately and made more flexible.[20] The new office of Chief Economist created within the Competition Directorate General, together with the newly established European Advisory Group on Competition Policy (EAGCP), should provide a more economic approach to the Commission's analysis.

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15 For example, the Airtours/First Choice case took almost three years from Commission decision to CFI final judgment. In another highly controversial case – GE/Honeywell – the CFI judgment came almost five years after the merger notification.

16 For a detailed comparison of different regulatory practices see, for instance, Röller et al. (2000).

17 According to CFI judgments, the Commission did not conduct a sufficiently rigorous economic analysis of the incentives for and ability to coordinate behavior in Airtours/First Choice, and it failed to take account of the different degree of competition in each of the national markets in the Schneider/Legrand case. In Tetra Laval/Sidel, the Commission's concerns over leveraging market power between two otherwise separate markets could not be legally justified. In addition, the CFI criticized the Commission for a low standard of proof and unnecessary structural remedies.

18 See the Green Paper on the Review of Council Regulation (EEC) No 4064/89, COM (2001) 745/6 final, 11/12/2001.

19 Under the "one-stop shop" rule, national authorities cannot carry out a competition review where the Commission has jurisdiction, and a decision by the Commission covers the whole EU.

20 Phase I has been prolonged to a maximum of 25 + 35 = 60 working days (formerly 10 weeks), while Phase II can currently take up to 90 + 20 + 15 = 125 working days (formerly four months).

The core of the reformed ECMR is a new prohibition criterion (SIEC)[21], which replaces the old dominance test and gives the Commission more "manoeuvring space" for merger appraisals.[22] The newly published Horizontal Merger Guidelines (HMR)[23] should provide guidance on how the Commission assesses horizontal mergers and is in line with the modern economic theory of industrial organization. Among other things, the HMR explicitly differentiates between coordinated and non-coordinated effects, thus closing the existing enforcement gap in cases of oligopoly markets where mergers would have anti-competitive effects without creating or fostering dominance. On the other hand, the Guidelines also explicitly list the potential countervailing factors that can result in merger approval despite the market dominance of merging parties, thus giving merger parties more scope for defense against potential rejections from the Commission.[24]

The key goal of the new legislation was to provide a more transparent, efficient and "consumer oriented" approach in line with the competition criteria applied in the US and UK. The aim of this paper is to empirically test the quality of EU merger control in the last two decades and to provide an insight into the effects of the 2004 reform on the overall efficiency of the new merger regulation. We use stock market data to identify merger cases that the market expected to hurt (anti-competitive) or benefit (pro-competitive) consumers. We then compare this information with the real decisions made by the Commission and identify discrepancies between the assessment of the market and that of the regulator, i.e., instances in which the Commission blocked pro-competitive mergers or approved anti-competitive mergers. Consequently, we run a simple regression model to find the main factors driving the occurrence of these discrepancies and we test for significance in the effects of the recent regulatory reform on the data.

## 1.2. Literature Overview

The event study approach, using the movements of stock prices to assess the effect of a particular event on a firm's value, was first applied by Dolley (1933), then further developed mainly by Ball and Brown (1968) and later by Fama et al. (1969). A significant share of the event study research has focused on the ability of mergers to create value for shareholders of merging parties; see Andrade et al. (2001) for an extensive overview of M&A research.

Considerably less attention has been given to applications of this methodology for competition policy purposes. Such an analysis first appeared in Eckbo (1983), who evaluated

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21 SIEC stands for Significant Impedance of Effective Competition and is defined in Article 2 (3) of the ECMR as "A concentration which would significantly impede effective competition, in the common market or in a substantial part of it, in particular as a result of the creation or strengthening of a dominant position, shall be declared incompatible with the common market."

22 While in the old test dominance could be considered a necessary condition for merger prohibition, the dominance criterion in the new test is incorporated only as an example of how concentration can impede effective competition.

23 Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings (2004/C 31/03).

24 For more details on the desirability of an efficiency defense in merger control, see Lagerlöf and Heidhues (2005).

259 US mergers, of which 79 were challenged by the antitrust authorities. Eckbo examines movements in the share prices of competitors to see whether they supported the anti-competitive nature of the mergers and found they did not. According to his results, challenged mergers had been based on synergistic effects rather than increases of market power and potential collusive behaviour. Stillman (1983) conducts a smaller study with a similar aim where the results were consistent with those of Eckbo. Both studies find a lack of significant statistical evidence from stock price movements to support referral to the antitrust authorities on competition grounds.

The first study using the event study method to examine EU merger control, conducted by Brady and Feinberg (2000), analyses the effect of particular news on EU merger procedures, for instance regarding decisions to open Phase II investigations. They focused on stock market reactions to news of the merging parties and found that enforcement of the merger regulation has a substantial effect on individual company stock values.

Neven and Röller (2002) analyse 100 EU merger cases from the first ten years of EU merger control in order to explore the main factors that may account for discrepancies between the Commission's decisions and the reactions of the stock market. Using a simple correlation analysis, they found that discrepancies could be associated with the political economy of merger control, that discrepancies are more frequent in Phase I investigations and when large countries are involved, and that competitors may play an important role in favour of anti-competitive deals.

Bergman et al. (2003) use the insights of Coate and McChesney (1992) in analysing EU merger cases and trying to account for decisions to open a Phase II investigation and decisions to prohibit a merger in terms of the factors listed in the final documentation. They test whether the Commission gives appropriate weight to factors regarded as important ex ante (for instance published in merger guidelines) and to factors regarded as important by economic theory (market shares, barriers to entry, etc.).

Duso et al. (2005) analyse the stock market's ability to identify potential anticompetitive effects and remedial provisions on transactions assessed by the Commission. They find that the market seems able to predict the effectiveness of the remedies applied in Phase I and to produce good estimates prior to Phase II clearances and prohibitions, but not remedies.

Duso et al. (2007) follow Eckbo (1983) and Stillman (1983) in order to identify "errors" in the Commission's merger decisions in the period 1990–2002. They rely on the theoretical framework from Farell and Shapiro (1990), using a unique correspondence between changes in profits of competitors and consumer welfare to identify anti-competitive mergers. They further apply the theoretical framework from Neven and Röller (2005), according to which an antitrust agency maximizes its own utility and third parties (firms, governments, etc.) can affect its utility, and they build a regression model to analyse the determinants of the Commission's decision making. Their results suggest that the Commission's decisions cannot be solely accounted for by the motive of protecting consumer welfare. Instead, they suggest that other factors – such as country and industry effects, as well as market definition and procedural aspects – affect the decision making of the EU antitrust agency.

Last but not least, Aktas et al. (2007) use an event study approach to evaluate the hypothesis that the EU merger regulation is protectionist. They analyse whether the market considers the prospect for regulatory intervention in its initial assessment of proposed mergers and test whether the Commission is biased against mergers involving non-EU firms. They conclude that for mergers initiated by foreign bidders, the probability of regulatory intervention was increasing with the magnitude of (negative) stock returns of European competitors around the merger announcement date.

Clearly from this review, merger control in the European Union is becoming an increasingly popular topic of empirical research, mainly due to the availability of relevant data. Nevertheless, none of the current studies assesses the most recent EU merger cases in light of the effects of the 2004 regulatory reform. In addition, most of the studies focus on a particular empirical question, while we apply a more holistic approach that provides an insight into the overall efficiency of EU merger control, as described further below.

## 1.3. Methodology

In our research, we follow the approach used by Duso et al. (2007), but we apply a slightly different (and in our view more appropriate) methodology for calculating abnormal returns and for the subsequent calculation of competitors' gains from the merger. In addition, we use a different method for estimating the marginal effects of dependent variables in our model, a method that is better suited to PROBIT models with dummy right-side variables. The main contribution of this paper is that we constructed a unique sample of 161 horizontal mergers evaluated by the Commission between 1990 and 2008. Our sample offers an opportunity to gain the first insight into the effects of the recent EU regulatory reform on proposed mergers. Note that none of the previous studies worked with merger cases evaluated after 2002.

Our methodology can be divided into four main steps. In the first step, we provide some rationale behind the evaluation of a merger's competitive effects using changes in the market value of competitors. In the second step, we create a representative sample of horizontal mergers using publicly available information from the Commission's website and collect information about mergers and relevant competitors in our sample. In the third step, we use stock market data to calculate the abnormal change in the market value of competitors around the merger announcement date. This information is then used to identify the market's assessment of the competitive effects of the mergers in our sample and to recognize cases where there are discrepancies between the market's and the Commission's evaluation of the merger, i.e., cases where the Commission had prohibited mergers that the stock market regarded as pro-competitive as well as instances where the Commission had failed to prevent anti-competitive mergers. In the last step, we specify our econometric model using findings from the previous studies and we apply PROBIT regression to investigate the sources of the discrepancies between the market's and the Commission's evaluation of mergers, with a particular focus on the effects of the 2004 reform on the occurrence of these discrepancies.

### 1.3.1. Step 1 – Merger Assessment using the Event Study Approach

In order to evaluate the merger decisions of the Commission, we need to compare these to some independent criterion. In contrast to US antitrust procedures, where independent evaluations are undertaken by both the Federal Trade Commission and the Antitrust Division of the Department of Justice, the EU merger regulation does not offer any alternative institutional assessment and the Commission is solely responsible for the whole appraisal process. Instead, we use the stock market view on the expected effects of the merger on competitors to evaluate the merger's competitive effects.

In particular, we look at the effects of the merger announcement on share prices of competitors to assess the aggregate welfare changes resulting from the merger. This method relies on the theoretical framework developed by Farell and Shapiro (1990) showing that under some general assumptions there is a clear correspondence between the effects of horizontal mergers on consumers and competitors, i.e., if a merger results in increased profits of competitors, it will harm consumers and vice versa.

The main advantage of this approach is that we have an independent assessment of the merger's competitive effects which we can compare with the Commission's decisions. Moreover, we observe stock market reactions on the day of the announcement irrespective of whether the merger is approved by the Commission in the end. We thus avoid the censoring problem, as we can include in our sample cases where the merger was blocked by the Commission.[25]

The main disadvantage of this approach is that we need to rely on the ability of the stock market reaction to provide a timely and unbiased estimate of the firm's change in profit, even though that estimate may not be very precise. This assumption is closely connected to the semi-strong version of the efficient market hypothesis (EMH) (Brealey and Mayers, 1995). The empirical evidence of the EMH has a long history and there are literally hundreds of finance papers confirming the general conclusion that developed stock markets are semi-strong efficient, although the general belief in the efficiency of stock markets has been seriously undermined by the recent financial crisis. In addition, there is a question about the ability of studies using stock market reactions of competitors to distinguish between the expected anti-competitive effects of a merger and the other information revealed by the stock reaction, such as changes in the likelihood of future market configuration.[26]

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[25] However, censoring is not fully eliminated, as we naturally need to exclude from our sample all cases where relevant competitors, or their parent companies, are not publicly listed. Another censoring problem may arise due to sample selectivity of EU merger data. Note that we cannot collect relevant information for withdrawn cases, cases with no documentation, and the cases that were resolved in the "simplified procedure" under the new ECMR. We thus recognize potential censoring problems in our analysis, but it should be noted that none of these issues has been tackled in any of the previous studies.

[26] The main advantages and disadvantages of the event study method in the assessment of the competitive effects of mergers are also discussed in Duso et al. (2007).

### 1.3.2. Step 2 – Selection of Merger Cases and Identification of Relevant Competitors

First, we have to select a sample of suitable merger cases for our analysis. We use publicly available information from the Commission's website.[27] Given the large number of cases evaluated by the Commission (a total of 4,164 by the end of 2008) and the time intensity of the data collection process, we applied the following selective approach. We start with all 154 Phase II cases from the beginning of 1990 until October 2008. We have to exclude some of the most recent cases because of unavailability of Commission reports. We also exclude all the cases that the Commission considered to be of a purely vertical or conglomerate nature.

We then start with the identification of relevant competitors. One option, widely used in older studies focusing mainly on antitrust proceedings in the US, is to identify competitors according to their industry classification codes (i.e., SIC, NACE) and include all firms that belong to the same industry as merging parties.[28] Such a method assures a sufficient number of observations, but it increases the risk of including firms irrelevant to the competitive effects of the merger, as industry classification codes provide only a rough estimate of the real competitive setup of a particular market. Some firms with the same classification code might be customers or suppliers of the merging parties. Therefore, empirical results from such a sample might be significantly biased.[29]

In order to avoid the shortcomings of this approach, we follow the method applied in more recent studies that deal with the EU merger regulation and we work only with the competitors identified by the Commission's economic team. The biggest advantage of this approach is that the Commission's experts have made a careful market definition – every merger case report includes a clear definition of relevant product and geographical markets as well as a list of competitors present in those markets.

The main disadvantage is obviously that we rely on the information provided by the Commission to evaluate its own decision making, and our results might be biased as a consequence of this endogenous inconsistency. If the Commission selectively picks relevant competitors to support its final decision, our results are likely to underestimate the occurrence of discrepancies between the Commission's evaluation and the market evaluation based solely on movements of the share prices of competitors.

Nevertheless, we still consider this approach to be more suitable for our purposes than identification using industry classification codes. The main reason – besides the above-described shortcomings of industry classification codes – is the transparency and replicability of the Commission's methodology whereby relevant product markets and subsequently relevant competitors are identified. The Commission's approach to defining relevant

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27 Available at http://europa.eu.int/comm/competition/mergers/cases.

28 See Aktas et al. (2007) for an overview of relevant studies.

29 As pointed out by Clougherty and Duso (2008), if we treated customer-firms as competitors, the abnormal returns would be biased upwards – synergies generated by merger will lead to lower prices for customer firms. Including firms with no relation to the merging parties in our sample would generate bias of competitors' abnormal returns toward zero, because such firms would be unaffected by the merger.

markets is clearly set in an official notice describing the main economic principles and procedures the Commission should follow.[30] The final case decisions are publicly available and reveal to what extent the Commission followed the recommended methodology. In addition, the Commission methodology can be subject to judicial review (both by the Court of Justice and by the CFI) and the Commission's decisions (including the market definition) are regularly challenged in court.[31] These significant constraints on the Commission's behaviour thus limit the scope of the above-described bias in our analysis.

For horizontal Phase II mergers with available documentation, we further analyse the Commission's reports and collect information on companies identified as competitors, and we exclude from our sample all cases where main competitors (or their parent companies) are not publicly listed.[32] Similarly, we exclude all "2 to 1" cases, i.e., situations where the merging parties are the only two firms present in the relevant market and there is no competitor left after the merger.

Finally, we end up with 72 Phase II cases suitable for our analysis. In order to obtain a relatively representative sample and to avoid sample selection problems, we follow the approach used in previous studies, we randomly select a sub-sample of Phase I cases, we apply the identical elimination process described above, and we end up with a total number of 89 Phase I cases in our sample.[33] For our sample of 161 merger cases we then collect all the relevant information from the Commission reports: the names and locations of the merging firms, the names of all relevant competitors, the product and geographical market definitions, and the final decisions.[34]

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30 See Commission Notice on the definition of relevant market for the purposes of Community competition law (97/C 372/03). In a preliminary analysis, the Commission investigates whether product A and product B belong to the same market and looks at the geographic market by analysing market shares, prices charged, etc. The Commission then carries out a more detailed analysis based on the concept of demand and supply substitutability. In addition, it examines the conditions in which the firms in question operate, taking account of recent developments in the market, the results of market studies analyzing consumer preferences, regulatory and other barriers to entry, and the views of the merging parties' customers and competitors.

31 See the comprehensive list of competition-related European courts judgments available at http://ec.europa.eu/competition/court/index.html.

32 This is again a potential source of bias not discussed in previous studies. Estimating the direction and size of this bias is, however, very difficult. One of many possibilities is that by excluding cases with non-listed competitors, we are underestimating the foreclosure effects of pro-competitive mergers. Assuming that a large share of non-listed competitors are smaller firms with limited access to financing, a pro-competitive merger leading to lower prices that disrupt revenue streams of competitors is more likely to force a non-listed firm – unable to adapt to the lower prices – to exit the market. This would lead to higher market concentration and subsequently lower competition in the market.

33 We realize that Phase II cases are over-represented in our sample compared to their real occurrence. We follow the approach of Duso et al. (2007) and do not consider this a significant measurement problem, although we realize the potential sample selection bias.

34 Our sample is obviously not fully representative for multiple reasons: i) over-representation of phase II case, ii) excluding cases where no documentation available, iii) excluding cases where merging firms not listed, iv) excluding cases where competitors not listed. Therefore, our analysis relies on 'bigger' and more recent merger cases, but it is not clear that this is causing any obvious bias in the results of our analysis.

### 1.3.3. Step 3 – Construction of Competitor Gains

For each merger in our sample we determine the first day the merger announcement appeared in the financial press.[35] For each of the 348 competitors in our sample, we collect data on stock prices[36] ( $P_{it}$ ) as well as on the number of shares ( $S_{it}$ ) on the announcement date, 260 days before this date as well as 3 days after it to construct the abnormal returns around the announcement date. We also collect "market data" for the same period; in particular, we used a country-relevant industry index provided by Datastream ( $I_{it}$ ).

In order to estimate abnormal returns on the announcement date, we use the market model approach (Brealey and Myers, 1995):

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

Note that Duso et al. (2007) apply an "index model" – a specific form of the market model where *α* is set equal to zero and *β* equal to one. However, this method is more suitable for the analysis of IPOs, where no historical data are available. We avoid this unnecessary simplification and we estimate parameters *α* and *β* using historical data. In particular, we employ stock returns over the 200-day trading period ending 60 days prior to the announcement date.[37] We exclude the 60-day period in order to minimize the potential "pre-announcement rumors" effect – information about a prospective merger usually appears in public before the official merger announcement. Including this period could thus bias our estimates.[38] Using the standard OLS approach we estimate the model parameters, which we then use to predict firm *i*'s normal return on the announcement date, i.e., we estimate the stock price return for the hypothetical event where the merger would not have been announced ( $\hat{R}_{it}$ ).

Consequently, we calculate the abnormal return around the merger announcement date *t* ( $AR_{it}$ ). Given the possibility of information leaks, which influence firm *i*'s return before (or after) the merger announcement, and the fact that the market might not absorb the

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35 The announcement date was obtained from "Dow Jones Factiva" (a customizable business news and research product that integrates content from newspapers, newswires, journals, research reports, and web sites).

36 Stock market data were obtained from "Thomson Datastream" (the world's largest statistical and financial database). All prices were transformed into constant 2000 USD thousands.

37 Note that there is no clear agreement in the previous literature on the optimal length of the estimation period. Eckbo (1983) estimates the parameters of the market model using the 400 days surrounding the announcement day (day 0) excluding period -50 through 50. Brady and Feinberg (1998) stop the estimation period 10 days prior to the first announcement date. Duso, Gugler, and Yortoglu (2005) estimate the market model over 240 trading days ending 20 days prior to the announcement day, while Clougherty and Duso (2008) use an identical trading period that ends 60 days prior to the announcement date. Aktas et al. (2007) use 200 daily observations during a period that ends 30 days before the initial announcement day. In line with Duso et al. (2007) we follow a conservative approach estimating the market model over 200 trading days while excluding a relatively long period of 60 trading days before the merger.

38 Including the period immediately before the announcement day would result in underestimation of abnormal returns, as the estimated parameters of the market model would already capture part of the effect of the merger announcement on the competitor's share price.

announcement information quickly enough, we define the total effect as a cumulative abnormal return (CAR): the sum of the daily abnormal returns within an event window of a particular length. We compute the CAR for event windows of different lengths ($\tau_1$ before and $\tau_2$ after the announcement date), in particular 1, 2, and 3 days around the announcement date:

$$CAR_{i,\tau_1,\tau_2} = \sum_{t=\tau_1}^{\tau_2} AR_{it} = \sum_{t=\tau_1}^{\tau_2} (R_{it} - (\hat{\alpha} - \hat{\beta} R_{mt}))$$

Based on this data we construct the main competitors' gain from merger variable, which we use for the assessment of the merger's competitive effects. The main competitors for each merger are firms that the Commission identifies to be present in all relevant markets and are thus most likely to be influenced by the merger.39 First, for each main competitor i we calculate the individual gain from the merger ($\Pi_i^{CG}$)40:

$$\Pi_i^{CG} = \sum_{t=\tau_1}^{\tau_2} (AR_{it} \cdot P_{it} \cdot S_{it})$$

For each merger case J in our sample, we then calculate the "average" competitors' gain from the merger ($\Pi_J^{CG}$) as the weighted average of the above-defined individual competitor gains.41 The average market capitalization for a given 200-day trading period is used as the weight.

$$\Pi_J^{CG} = \frac{\sum_{i \in J} \Pi_i^{CG} \cdot \overline{P}_{it} \cdot \overline{S}_{it}}{\sum_{i \in J} \overline{P}_{it} \cdot \overline{S}_{it}}$$

For each merger case we compare the average competitors' gains with the Commission's final decision. We evaluate the Commission's decision as a "type I discrepancy" in cases where a merger was prohibited (Article 8.3) while the market considered it pro-competitive ($\Pi_J^{CG} < 0$). Given the low number of prohibitions in the history of EU merger control, we expanded the definition of a "weak type I discrepancy" to include cases where a merger was

39 The right treatment of relevant competitors when estimating a merger's competitive effects is in fact a complex question. The method suggested by Duso et al. (2007) is to use all competitors available for one specific merger irrespective of the relevant market in which they are present. Another approach is to use each single relevant market as a separate observation and then correct for the correlation among these observations with a clustering procedure at the merger level. Our approach, where we work only with competitors present in all relevant markets, might be considered a compromise between these two methods.

40 In those cases where main competitors are absent, we use major rivals from each relevant market and control for those cases in our further analysis.

41 Note that in about 60% of cases the stock reaction of individual competitors had the same sign as the aggregate competitors' gain $\Pi_J^{CG}$.

prohibited or approved with remedies (Article 6.1.b or Article 8.2), while the market considered the merger to be pro-competitive. Furthermore, we classify a "type II discrepancy" for cases cleared by the Commission with no objections (Article 6.1.b or Article 8.1) where the stock market reaction was positive ($\Pi_J^{CG} > 0$), thus indicating an anti-competitive nature of the merger.

### 1.3.4. Step 4 – Econometric Model

#### *1.3.4.1. Model Specification*

Our econometric model is based on the theoretical framework of Neven and Röller (2005), which specifies that an antitrust agency maximizes its own utility and where third parties (firms, governments, etc.) can affect the agency's utility. We assume a linear relationship between the occurrence of both types of discrepancies (*type 1 discrepancies – T1*, *type 2 discrepancies – T2*) and various explanatory variables (*X*) that are observable and can potentially influence the decision making of the agency.

$$T1 = \sum_{i=1}^{k} \alpha_i X_i + \varepsilon_i \qquad (1)$$

$$T2 = \sum_{i=1}^{k} \beta_i X_i + \varepsilon_i \qquad (2)$$

Based on previous studies, we identify factors that might affect the occurrence of discrepancies and we specify equations *(1)* and *(2)* as follows:

$$\begin{aligned} T1 = {} & \alpha_0 + \alpha_1 \tilde{\Pi}^{CG} + \alpha_2 BIG\_EU + \alpha_3 PH\_II + \alpha_4 TREND + \alpha_5 NATIONAL + \\ & + \alpha_6 CROSS\_EU + \alpha_7 EXTRA\_EU + \alpha_8 ECMR\_2004 + \alpha_x X + \varepsilon_1 \end{aligned} \qquad (3)$$

$$\begin{aligned} T2 = {} & \beta_0 + \beta_1 \tilde{\Pi}^{CG} + \beta_2 BIG\_EU + \beta_3 PH\_II + \beta_4 TREND + \beta_5 NATIONAL + \\ & + \beta_6 CROSS\_EU + \beta_7 EXTRA\_EU + \beta_8 ECMR\_2004 + \beta_x X + \varepsilon_2 \end{aligned} \qquad (4)$$

**Table 1** presents the list of variables used for the specification of the model:

**Table 1:** Definition of Variables

| Variable | Definition |
|---|---|
| | ***Dependant Variables*** |
| *T1* | Dummy = 1 if a pro-competitive merger was blocked or cleared with remedies. |
| *T2* | Dummy = 1 if an anti-competitive merger was cleared without remedies. |
| | ***Independent Variables*** |
| $\tilde{\Pi}^{CG}$ | Expected gains from mergers for the competitors. Cumulative change in stock market value (relative to an index) for the competitors on the day around the first announcement date of the merger. The value is expressed in 2000 constant USD (thousands). |
| *Big_EU* | Dummy = 1 if one of the merging part comes from one big EU country (France, Germany, Italy, Spain, UK). |
| *Ph_II* | Dummy = 1 if the merger decision was made in Phase II proceeding. |
| *Trend* | Official number of the merger case - captures increasing number of evaluated cases more efficiently then the date (year) of the official merger announcement. |
| *National* | Dummy = 1 if the relevant geographic market is national. |
| *Cross_EU* | Dummy = 1 if the acquirer comes from the country outside the EU and the merger target comes from the EU. |
| *Extra_EU* | Dummy = 1 if the both merging parties come from the countries outside of the EU. |
| *ECMR_2004* | Dummy=1 if the merger was evaluated under the new ECMR. |
| *Network* | Dummy = 1 if the merger concerns telecom, transports, electricity or the financial industry. |
| *Vertical_Eff* | Dummy = 1 if the Commission identified vertical or conglomerate effects. |
| *No_Main_Competitor* | Dummy=1 if there is not at least one competitor active at all merger--relevant product markets. |
| *Same_Country* | Dummy = 1 if the both merging parties come from the same country. |

The following section provides a more detailed discussion on the explanatory variables used in our model.

### *Power of Competitors*

The Commission is often criticized for giving excessive attention to the welfare of competing firms.[42] Typically, during the merger evaluation procedure, the Commission takes into account the concerns of competitors and their views on the competitive effects of the proposed merger. This apparent willingness to listen to competitors gives rise to concerns about the possible influence of competitors on the final decision of the agency. For this reason, we include a proxy for the competitors' incentive to influence the Commission's

42 See Neven and Röller (2002) for further details.

decision, measured as the expected change in the market value of the main competitors ( $\widetilde{\Pi}^{CG}$ ).

***Institutional Factors***

There are a number of institutional and political economic variables that may influence the Commission's decision making. As suggested in previous studies[43], the size of the country in which the merging firms originate does play a role in the Commission's decision – large countries might, for instance, exercise significant political pressure to have an anti-competitive transaction cleared if it benefits their national champions, thus increasing the occurrence of type II discrepancies. We therefore control for cases where the merging parties are from large EU member states (variable *Big_EU*).

***Procedural Issues***

Regarding procedural issues, some critics have pointed out the inadequacy of Phase I proceedings, as the Commission might not have enough time and resources to evaluate complex merger cases properly.[44] Therefore, we test whether the occurrence of type II discrepancies is positively correlated with Phase I proceedings (variable *PH_II*).[45]

Another question that arises with respect to the Commission's expert teams is their increasing workload. While the average number of transactions evaluated during the period of 1990–1999 was only 124 cases per year, the expert teams' workload almost tripled in the last decade, reaching 321 cases per annum between 2000 and 2008. We thus control for the effect of increasing workload in our model (variable *Trend*).

Another issue of concern is the market definition applied in the Commission's analyses. Neven et al. (1993) claim that EU merger guidelines are biased toward excessively narrow market definitions, both in terms of the wording of the guidelines and in actual practice. As a result, a narrow market definition may be associated with a higher frequency of type I discrepancies, i.e., too narrowly defined markets might result in exaggeration of the anti-competitive effects of the merger in particular submarkets, neglecting the overall competitive dynamics of the market concerned. We use all cases where the Commission identified the relevant geographical market as national in scope as a proxy for narrow market definition (variable *National*).

***Preference for Domestic Firms***

Disagreements between the EU and US regulators in cases that fall under both legislations (in particular in the *GE/Honeywell* and *Boeing/McDonnell Douglas* mergers and in the *Microsoft* antitrust case) uncover another important issue –potential protectionism of domestic firms in the EU. The financial press has often raised the suspicion that the EU

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43 See Duso et al. (2007) for further details.

44 See Neven and Röller (2002) for further details.

45 Strong type I discrepancies, i.e., pro-competitive mergers blocked by the Commission, are in this case irrelevant as mergers cannot be blocked in Phase I proceedings.

focuses more on the protection of domestic competitors rather than consumers.[46] Aktas et al. (2007) find that the more harm suffered by European rival firms when the acquirer is from outside the European Community, the greater the likelihood of European regulatory intervention against the proposed combination. Such evidence does not support an unambiguous conclusion of protectionism, but it certainly raises some doubts. We therefore distinguish the type of the mergers in our sample – intra-European, extra-European, and cross-euro-border mergers – to control for this potential effect (variables *Cross_EU* and *Extra_EU*).

***Effect of the 2004 Reform***

We include a variable that should at least partially capture the recent legislative changes in the EU merger regulation (variable *ECMR_2004*).[47] The promised consumer-oriented approach in the evaluation process, clear specification of countervailing factors, and prolonged investigation periods might have had a positive effect on the Commission's accuracy. We thus expect lower occurrence of both type I and type II discrepancies since the introduction of the new legislation.

In light of the above discussion, the right side of both equations consists of other factors that could affect the occurrence of both types of discrepancies. The vector X contains other important controlling variables, such as specific treatment of mergers in network industries (variable *Network*) and the presence of vertical effects (variable *Vertical_Eff*) – see above.

#### *1.3.4.2. Model Estimation*

***PROBIT Regression***

Following the methodology applied in previous studies, we use PROBIT regression to estimate equations *(3)* and *(4).* The PROBIT model can be derived from the assumption that there exists a latent unobservable variable *P** – in our case the Commission's view on the anti-competitive effects of the merger. If the latent variable takes a value above some critical level, then the merger is prohibited (*P=0*), otherwise it is approved (*P=1)*. Thus, for each subsample (pro-competitive and anti-competitive mergers) we estimate the parameters of the model assuming that the latent variable is generated by the model:

$$P^* = \beta' X + \varepsilon \qquad (5)$$

where $\beta$ is a vector of parameters (weights), $X$ is a vector of explanatory variables, and $\varepsilon \sim N(0,1)$ is a random shock. It is then easy to show that:

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46 See for instance the Financial Times articles by J. Johnson, "A poor prescription for French national champions" from 27 March 2004 and by A. Michaels, "Ambassador for US blasts Rome on Protectionism" from 20 April 2007.

47 The limited size of our sample allows us to test only the "base" effect of the regulatory reform, i.e., looking for the significant changes in the model intercept for the subsample of cases evaluated under the new merger regulation.

$$\Pr(P=1)=\Phi(\beta' X) \qquad (6)$$

This gives us the likelihood for both cases, *P=0* and *P=1*. Assuming the observations are i.i.d., it is easy to construct the sample log-likelihood. This can be maximized using standard nonlinear maximization algorithms.

However, we should note that the announcement of a merger states the intention of the merging parties and it is usually subject to review by antitrust agencies. Therefore, the stock market reaction to the particular event reflects not only the estimate of the change in the future performance of the merging parties, but also the likelihood that the deal will be cleared. The change in the value of the stock at the time of the announcement is equal to the probability of clearance times the value that will be generated by the transaction. Therefore, the anticipated profits cannot be exogenous, as the market takes into account the antitrust procedure (Aktas et al., 2007).[48] In order to overcome the endogeneity of the observed competitors' gains, we use the approach of Duso et al. (2007). First, we estimate the PROBIT model, regressing the probability of merger clearance on the subset of relevant exogenous variables. Then, for each merger case in our sample we divide the observable competitors' gains by the predicted probability of the merger being cleared, i.e., we are able to reconstruct the real effects of the merger on competitors' profits and use them in estimating equations *(3)* and *(4)*.[49]

***Marginal Effects***

The equation coefficients estimated by the PROBIT regression do not illustrate the partial effects of a change in a particular explanatory variable on the dependent variable, as is the case for linear regression models. A default method to overcome this difficulty, offered by most statistical packages, is to calculate the marginal effects (partial derivatives) at the values of the independent variables fixed at their sample means. This is the standard method used for the calculation of marginal effects in previous studies (Duso et al., 2007).

Note, however, that this approach has two main limitations. Firstly, the formula is not very intuitive in the presence of dummy variables: the sample means used in the calculation of marginal effects refer to nonexistent observations, as the dummy variable never takes the value of its sample mean. Secondly, this method might generate estimation bias in the presence of observations where one continuous variable takes extremely high (low) values.[50]

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48 Note, however, that we only need the sign of the expected stock price change in order to evaluate the competitive nature of the merger used for identification of type I and type II discrepancies, as the probability of the merger being cleared is always non-negative.

49 Let $\Pi^{CG}$ be the abnormal change in the value of competitors' stocks on the day of announcement of the merger. Let the *p* be the probability that the market assigns to the event that the merger is cleared. Then $\Pi^{CG}$ = p $\tilde{\Pi}^{CG}$ can be interpreted as the expected change in competitors' value conditional on the event that the merger is cleared by the antitrust authority. Since p must be non-negative, $\tilde{\Pi}^{CG}$ and $\Pi^{CG}$ have the same sign, enabling us to identify anti-competitive (pro-competitive) cases using only the observed reaction of competitors' stocks.

50 This is exactly the case of our sample. ΠCG takes extremely high values for observations where large corporations are identified as competitors (such as AT&T with its market capitalization of almost USD 30 billion). Those observations push the sample mean of ΠCG well above its median value, and most of the observations in

To remove these limitations, we follow the method suggested by Bartus (2005), which is becoming increasingly popular among researchers in social sciences working with large sets of dichotomous control variables.[51]

We define average marginal effects (AME) as the average amount of the change in the expected value of a dependent variable:

$$AME_i = \beta_i \frac{1}{n} \sum_{k=1}^{n} f(\beta x^k) \qquad (7)$$

where $\beta x^k$ denotes the value of the linear combination of the parameters and variables for the $k^{th}$ observation.

In order to estimate the marginal effects for dummy variables we use the following formula:

$$AME_i^D = \frac{1}{n} \sum_{k=1}^{n} \left\{ F(\beta x^k \mid x_i^k = 1) - F(\beta x^k \mid x_i^k = 0) \right\}$$

$$(8)$$

Using the formulas above, we calculate the average marginal effects across the full sample, thus avoiding the problem of setting dummy variables at their means, as well as the potential negative effect of extreme values of continuous variables. Note that we use "marginal effects" in the following sections only for explanatory purposes while in fact we always refer to the AME.

## 1.4. Results

### 1.4.1. Descriptive Results

Our sample includes selected EU merger cases completed by the Commission in the period 1990–2008. We work with 72 Phase II cases, 89 Phase I cases, and a total number of 348 competitors with complete information. As described in the previous section, we computed the abnormal returns of competitors around the announcement day. The cumulative average abnormal returns (CAARs) of the competitors in our sample are -0.13%, -0.24%, and -0.33% for the 3-, 5-, and 7-day event windows, all being statistically significant at the 5% significance level. The negative competitors' CAARs would suggest that EU mergers are evaluated by the market as pro-competitive on average, which is in line with Aktas et al. (2007), who find the competitors' CAAR to be negative at -0.24% during an 11-day event window. On the other hand, Clougherty and Duso (2008) find a positive competitors' CAAR

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the sample have ΠCG below the mean. By computing the marginal effects at the fixed means we underestimate the effect of dummy variables, making the variable ΠCG the perfect predictor. Instead of excluding observations with extremely high ΠCG, we apply the method suggested by Bartus (2005), which overcomes this problem.

51 See, for instance, Hytinen and Ilmakunnas (2007) and Jens et al. (2008). Note that Bartus (2005) only focuses on AME calculation in STATA. For a more conceptual discussion, see Chamberlain (1984, p. 1,274).

of 0.37% over the 3-day event window. In general, there is mixed evidence on the effects of mergers on rivals – see Aktas et al. (2007, p. 1,106) for a recent overview.

For each merger case, we calculated the average competitors' gain ($\Pi^{CG}$) as the weighted average of changes in the market value of main competitors, and we identified the discrepancies between the Commission's evaluation and the market evaluation of the merger. As can be seen from **Table 2**, the distribution of discrepancies does not vary significantly and we therefore focus only on results from the 5-day window in our further analysis.

**Table 2**: Frequency of Discrepancies by the Different Window Lengths (in %)

| | **Frequency of discrepancies** | | |
|---|---|---|---|
| Window length | Type I | Weak Type I | Type II |
| 3 days window | 5,81 | 22,05 | 56,33 |
| 5 days window | 4,76 | 22.62 | 55,84 |
| 7 days window | 3,70 | 20,80 | 58,25 |

**Table 3** reports the number of cases in our sample according to the decisions taken by the Commission and according to the stock market evaluation of the merger's competitive effects. Unconditional clearances are associated with Article 6.1.b decisions in Phase I, as long as they do not involve conditions, and with Article 8.1 decisions in Phase II. Similarly, prohibitions are associated with Article 8.3 decisions (only in Phase II). Cases cleared with remedies imposed on the merging parties are associated with Article 6.1b – decisions with conditions (Phase I) or with Article 8.2 decisions (Phase II). We observe that 52% of all cases are classified as pro-competitive. Given that a merger is pro-competitive, only 4 out of 84 cases (4.76%) are blocked and involve strong type I discrepancies. Weak type I discrepancies are observed in 19 out of 84 cases, or some 22.6%. Given that a merger is anti-competitive, 43 out of 77 cases (55.8%) involve type II discrepancies.

**Table 3**: Decisions and Competitors' Gains

| | **Phase I** | | **Phase II** | | | |
|---|---|---|---|---|---|---|
| | Art 6.1.b (Cleared) | Art 6.1.b (Cleared with remedies) | Art 8.1. (Cleared) | Art 8.2. (Cleared with Remedies) | Art 8.3. (Prohibited) | |
| Negative Gains (pro-competitive) | 43 | 3 | 18 | 16 | 4 | 84 |
| Positive Gains (anti-competitive) | 33 | 4 | 10 | 26 | 4 | 77 |
| Total | 76 | 7 | 28 | 42 | 8 | **161** |

Note also that our data identify as strong type I discrepancies in two out of three cases that were later overturned on appeal by the CFI – namely, the *Airtours/First Choice* and *Tetra*

*Laval/Sidel* cases. The other controversial case – *Schneider/Legrand* – was not identified as an error.[52]

Regarding conditioning error occurrence on the particular Commission decision, our data find that the number of strong type I discrepancies in relation to the total number of prohibitions is 4 out of 8 (50%). Excluding those cases where the Commission raised serious concerns about possible foreclosure of competitors, we get 3 out of 8 (37.5%).[53] With respect to weak type I discrepancies, the total number is 23 out of 57 (40.4%), or 17 out of 57 (29.8%) when controlling for foreclosure effects. Regarding type II discrepancies as a percentage of all mergers that were cleared, our data suggest that the share is around 41.3% of the cases in our sample.[54]

The estimation of equations *(3)* and *(4)* proceeds by splitting our dataset into anti- and pro-competitive subsamples. In particular, we estimate *(3)* on the sample of pro-competitive deals ($\Pi_J^{CG} < 0$). We use the weak definition of type I discrepancies for construction of our dependent variable – we set *T1 = 1* when a pro-competitive merger was blocked or cleared with remedies. Equation *(4)* is estimated on the sample of all anti-competitive deals ($\Pi_J^{CG} > 0$) and we set *T2 = 1* if an anti-competitive merger was cleared without conditions.[55] The summary statistics are provided in **Table 4** in **Annex 1**.

### 1.4.2. Weak Type I Discrepancies

The results are presented in Table 5 and Table 6 in **Annex 1.** Our results suggest that the occurrence of discrepancies between the Commission and market evaluations cannot be explained by the random process, i.e., there are other factors that determine the occurrence of these discrepancies.

Regarding the power of competitors, our results suggest that competitors have no influence over the Commission's decisions as far as pro-competitive mergers are concerned. With respect to preferential conditions for large EU countries, we find variable *Big_EU* to be significant at the 5% level. According to the estimates of marginal effects in **Table 7**, the

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52 A fourth appealed case, General Electric/Honeywell, was not included in our analysis due to the fact that the merger resulted in the creation of a monopoly in the market for large commercial jet engines – a so-called 2-to-1 case. For more details on the selection criteria see section 6.1.1.

53 In cases where a serious threat of foreclosure of competitors is identified, negative competitors' gains might reflect the possible exit of the competitor from the market rather than an expected increase of competitiveness in the market.

54 Compared with the findings of Duso et al. (2007), our results also identified about half of all cases as pro-competitive, but the frequency of errors conditional on merger competitiveness diverge: 4.75% of type I discrepancies, 56% of weak type I discrepancies, and 42% of type II discrepancies. Our dataset thus shows a higher occurrence of type II discrepancies and a lower frequency of weak type I discrepancies. Duso et al. (2007) find similar probabilities of the occurrence of both types of discrepancies, but in their case discrepancies occur in roughly one in four mergers that are cleared (or blocked).

55 The estimations were carried out using STATA 9.2 software. We controlled for collinearity and potential outliers. All standard errors are heteroskedasticity robust.

large EU countries have about a 20% lower chance of getting a pro-competitive deal curtailed by the Commission.

Considering procedural issues, we see that variable *Phase_II* is significant at the 1% significance level and has a positive sign, implying that weak type I discrepancies are more likely in Phase II. The probability of a pro-competitive deal being curtailed is about 50% higher in Phase II. On the other hand, the steadily increasing number of cases (*Trend*) appraised by the Commission does not have any significant effect on the occurrence of weak type I discrepancies.

The effect of the variable *National* is not statistically significant. Thus, narrowly defined markets do not lead to an unnecessary burden being imposed on pro-competitive deals.[56]

Our estimates suggest that there is no evidence of protectionist behaviour by the EU antitrust agency. While variable *Extra_EU* is statistically insignificant, the effect of *Cross_EU* is significant at the 5% level. Moreover, the probability of unnecessary remedies (or a prohibition) is about 23% lower when the acquirer comes from outside the EU. One possible explanation is that these large multinational mergers usually fall under the scope of several antitrust agencies. Therefore, the existence of multiple independent assessments might generate a disciplinary effect on the EU regulator.

With respect to the effects of the EU regulatory reform, we see that variable *ECMR_2004* is not significant at the 10% level. It should be noted, however, that the variable is not completely insignificant (the p-value being around 0.13) and that the marginal effect estimate suggests positive effects of the reform – weak type I discrepancies are 20% less likely for cases evaluated under the new ECMR.

Concerning the other controlling variables, we do not find any significant effect of network industries (*Network*), nor does the existence of vertical effects show any significant impact (*Vertical_Effects*). Cases where the merging parties come from the same country do not have any significant effect on the frequency of weak type I discrepancies either (*Same_Country*). The only significant controlling variable is *No_Main_Competitor* – the probability of weak type I discrepancies is about 17% higher for cases where several product markets were identified but none of the relevant competitors was present in all of the markets.[57]

We also control for the potential bias associated with the presence of foreclosure effects. As already mentioned, negative competitor gains might be induced by expected foreclosure of competitors rather than by increased competition in the relevant markets – these mergers would thus be wrongly classified as pro-competitive. Therefore, we exclude cases where the Commission raised concerns about the foreclosure effects of the merger and we re-estimate

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[56] Note again that we assumed that imposed remedies increase consumer welfare. Therefore, from the definition of weak type I discrepancies, imposing conditions and obligations on particular product markets only increases the overall positive effect of mergers evaluated as pro-competitive by the stock market.

[57] The interpretation of this result is rather ambiguous. One possible explanation is to connect those errors with a too narrow product market definition. However, there is also a potential measurement error resulting from the inability to capture the overall competitive effect of a merger.

equation *(3)* on this restricted sample. As we can see from **Table 4**, the parameter estimates do not change considerably. We observe a significant change in two parameters only.

First, the variable *National* becomes significant at the 10% level. If the Commission identifies at least one of the markets concerned as national, the probability of a weak type I discrepancy increases by approximately 13%. Second, the vertical effects of the proposed transaction seem to play a significant role now. The probability that unnecessary remedies will be imposed on a deal considered pro-competitive by the market decreases by 17% in the presence of vertical effects. The interpretation of this result is again ambiguous. One possible explanation is that our restricted sample does not cover any mergers where vertical (conglomerate) effects could potentially lead to the foreclosure of competitors. Vertical mergers that do not lead to the marginalization of competitors are usually considered beneficial for consumers, mainly due to elimination of double marginalization (Tirole, 1988). The incentive for the Commission to impose remedies might therefore be lower for merger cases where positive vertical effects are observed.

### 1.4.3. Type II Discrepancies

Turning to the analysis of type II discrepancies, our results again suggest that they cannot be considered random.

Regarding the influence of competitors, we find variable $\widetilde{\Pi}^{CG}$ to be significant at the 1% significance level. Interestingly, the coefficient has a negative sign, implying that the more positive the expected increase in competitors' value, the less probable it is that an anti-competitive merger will be cleared. This is slightly counterintuitive, as one would expect the effort of competitors to influence the agency to increase with the size of the anticipated gains from the merger, thus resulting in a positive relationship between $\widetilde{\Pi}^{CG}$ and type II discrepancies. One possible explanation is that the Commission takes into account the stock market reaction to the merger announcement when evaluating the proposed transaction. An overly optimistic reaction of competitors' stocks might potentially trigger a more careful assessment of the merger by the regulator. Note, however, that the magnitude of this effect appears relatively marginal. For illustration, an increase in equity of about USD 240 million around the announcement date – which equals the median gain in our anti-competitive sample – would result in an approximately 5% lower probability of a type II discrepancy. We thus consider the influence of competitors to be of minor importance.

The variable *Big_EU* is not significant and our results suggest that large EU countries cannot use their political power to get the Commission to clear anti-competitive deals.

Regarding procedural issues, the variable *Phase_II* is again highly significant and large in magnitude. The marginal effect implicitly shows that the probability of approving an anti-competitive merger is some 48% larger in Phase I. This observation is further supported by the significance of the *Trend* variable representing the increased workload coupled with the higher proportion of cases decided in Phase I proceedings. According to our results, the

probability that an anti-competitive merger will be cleared has increased slightly (on average by 2% p.a.) in the last decade.[58]

A narrow market definition (*National*) significantly increases the chances that the anti-competitive effects of a proposed merger will be recognized by the Commission. If the Commission identifies at least one of the markets concerned as national, the probability of an anti-competitive merger being cleared decreases by 13%. Note that, according to our data, the positive effect of the national market definition (a lower frequency of type II discrepancies) is of comparable magnitude to the negative effect arising from an unduly narrow geographic market definition (higher occurrence of weak type I discrepancies in our subsample corrected for foreclosure effects). However, given the significantly higher number of mergers cleared by the Commission and the negative effects of anti-competitive mergers on consumers, a higher frequency of weak type I discrepancies might be seen as a reasonable price to pay for the higher probability of identifying anti-competitive deals.

As in the case of weak type I discrepancies, our estimates suggest that there is no clear evidence of protectionist behaviour by the EU antitrust authority. While the variable *Extra_EU* is statistically insignificant, the effect of *Cross_EU* is significant at the 5% level. The negative marginal effect implies that anti-competitive mergers involving EU firms (both target and acquirer) have about a 21% higher probability of being cleared. Again, this might be explained by more careful examination of cross-euro-border cases rather than by systematic discrimination against foreign acquirers by the Commission.

The variable *ECMR_2004* is significant at the 10% significance level. Our results suggest a positive effect of the 2004 reform; type II discrepancies are about 22% less likely under the new EU merger control system. It therefore appears that the promised "economic approach" and the procedural improvements of the new ECMR have helped the Commission to better align its merger evaluations with market expectations, at least with respect to combinations assessed as anti-competitive by the market.

Considering the control variables, none of them proved significant.[59]

## 1.5. Conclusion

We collected a unique representative sample of 161 merger cases evaluated by the Commission in the period 1990 to 2008 and we empirically analysed the efficiency of EU merger control. We collected information on 348 relevant competitors and used stock market data to identify mergers that the market anticipated as anti-competitive. From this, we identified instances where the Commission had prohibited mergers that the stock market

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58 The average number of cases evaluated yearly is about 314 in the period 1998–2008. Using a rough estimate of the "average" marginal effect, we can simply multiply the average number of cases by the estimated marginal effect to get the change in the probability of a type II discrepancy.

59 Note that we controlled for potential misspecification of our model by excluding the insignificant control variables and repeating the PROBIT regression. Nevertheless, neither the sign of the coefficients nor the significance of the other variables changed. Therefore, we present the results including the insignificant control variables as well.

regarded as pro-competitive as well as instances where the Commission had failed to prevent anti-competitive mergers. Using the PROBIT model, we further investigated the sources of these discrepancies with a particular focus on the effects of the 2004 regulatory reform on the occurrence of these discrepancies.

In line with previous studies, our results suggest that the discrepancies between the Commission and the market are mainly driven by procedural and institutional factors. We also reject the claim that the Commission listens too much to competitors at the expense of consumers. To the extent one accepts that the primary objective of an antitrust agency is to protect consumers, these findings can be interpreted as in line with the Commission's broader objectives. Nevertheless, taking into account total welfare perspective (i.e. both consumer and producer surplus), this finding also raises interesting questions about the Commission's ability to appropriately consider efficiencies from the merger in their decision making. Based on authors' best knowledge, there has been limited number of merger cases in which the Commission decided to put a significant weight on the efficiencies argument and/or decided to allow a merger based on this type of evidence.[60]

Our evidence further suggests that mergers involving firms from large EU countries have a significantly lower probability of bearing unnecessary remedies imposed by the Commission. However, we did not find any evidence that the Commission is willing to clear anti-competitive deals involving firms from large Member States. We do not find any evidence supporting the alleged protectionist behaviour by the Commission, either. Our results suggest only that mergers involving a foreign acquirer are examined under closer scrutiny. We do recognise, however, that this finding may indicate that foreign acquirers are prepared to do more risky deals (in merger approval terms) than European firms. For instance, it is generally recognised that the US merger control tend to be less strict in terms of consumer protection vis-à-vis it's European counterpart. Therefore, it is plausible that US firm may be more aggressive on the acquisition deals in the EU than European firms, all else equal.

Procedural issues still play a significant role. The probability that an anti-competitive merger will be cleared is significantly higher if the final decision is made in a Phase I proceeding. This is accompanied by a significant effect of the increasing workload of expert teams on the occurrence of this type of discrepancy. On the other hand, Phase II proceedings often result in the imposition of unnecessary remedies on mergers evaluated as pro-competitive by the market. We believe that this could be for three reasons:

- first, it is possible that the Commission becomes more reluctant to approve a merger without remedies once the transaction goes into Phase II, as this would undermine the Commission's initial position of 'serious concerns' about the proposed merger;

[60] According to OECD (2012) *"To date the Commission has in a number of merger cases acknowledged the potential for procompetitive effects to satisfy the necessary conditions under EU merger control. These cases primarily concern non-horizontal merger cases, but also include horizontal mergers. At the same time, the Commission has so not identified a horizontal merger where the harm would have been counteracted or even outweighed by pro-competitive effects."*

- second, it is also possible that as a result of its in-depth investigation in Phase II the Commission discovers new potential issues with the proposed merger (which were not considered in Phase I) and decides to err on the side of caution by requiring remedies to address these specific issues, although they may not be anti-competitive to the extent that they would justify the remedies imposed); and

- third, the prolonged investigation in Phase II also implies that it is easier for third parties (i.e. competitors, consumer groups) to intervene in the proceeding and increase the probability of remedies being imposed.

On balance, given the significantly larger proportion of transactions decided in Phase I, the unnecessary remedies can be considered a reasonable price to pay for a higher probability of identifying anti-competitive mergers. Our data suggest a positive effect deriving from the 2004 reform, at least with respect to mergers evaluated as anti-competitive by the market. We found that for mergers appraised under the new regulation, the probability of an anti-competitive deal being cleared decreases significantly. We did not find any significant effect of the 2004 reform on the occurrence of weak type I discrepancies: the occurrence of unnecessary remedies has not decreased as a result of the new merger control system. [61]

We recognize a need for further research in this area, and more data could confirm the robustness of our results and fully capture the real effects of the recent regulatory reform of the EU merger control system. A larger data sample would allow for more advanced econometric analysis, enabling us to test the effects of the 2004 reform in more detail. We could, for instance, look at the systemic effects of the reform by testing whether there is any significant change in the slopes of relevant explanatory variables, i.e., something that the limited size of our current sample did not allow for. Another potential approach would be to look at the real ex-post effects of mergers on competition and prices in the relevant markets, instead of relying on the ex-ante evaluation provided by the stock market. Although this approach has a number of shortcomings, it would allow us to move away from the controversial efficient market hypothesis, on which our current approach depends heavily.

## 1.6. Annex 1

**Table 4:** Summary Statistics

| Variable | Obs. | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|

[61] An interesting question, not necessarily addressed in the current research is whether the Commission is becoming more or less likely over time to force mergers in the Phase II investigation, all else equal, and to what extent the merging parties themselves are becoming more comfortable going into Phase II investigation and getting more opportunity to convince the Commission about the strength of their pro-merger arguments.

| | | | | | |
|---|---|---|---|---|---|
| *W_Type_I (T1)* | 84 | 0.4167 | 0.4960 | 0 | 1 |
| *Type_II (T2)* | 77 | 0.6753 | 0.4713 | 0 | 1 |
| $\tilde{\Pi}^{CG}$ | 161 | 63302 | 1704696 | - 8105858 | 11500000 |
| *Big_EU* | 161 | 0.7019 | 0.4589 | 0 | 1 |
| *Trend* | 161 | 2275 | 1489 | 12 | 5123 |
| *National* | 161 | 0.3665 | 0.4833 | 0 | 1 |
| *Extra_EU* | 161 | 0.1180 | 0.3236 | 0 | 1 |
| *Cross_EU* | 161 | 0.1863 | 0.3906 | 0 | 1 |
| *ECMR_2004* | 161 | 0.2857 | 0.4532 | 0 | 1 |
| *Network* | 161 | 0.1429 | 0.3510 | 0 | 1 |
| *Vertical_Eff* | 161 | 0.3230 | 0.4691 | 0 | 1 |
| *No_Main_Comp* | 161 | 0.2360 | 0.4260 | 0 | 1 |
| *Same_Country* | 161 | 0.2609 | 0.4405 | 0 | 1 |

**Table 5:** Probit Results

| **Dependent variable** | **WType I discrepancies** | | **WType I discrepancies** Foreclosure Correction | | **Type II discrepancies** | |
|---|---|---|---|---|---|---|
| | **Coef.** | ***p*-Values** | **Coef.** | ***p*-Values** | **Coef.** | ***p*-Values** |
| $\tilde{\Pi}^{CG}$ | -1.74E-07 | 0.2310 | -2.59E-07 | 0.2550 | -1.63E-06 | 0.0000 |
| *Big_EU* | -0.9480 | 0.0470 | -1.0807 | 0.0350 | -0.8586 | 0.1280 |
| *Phase_II* | 2.0985 | 0.0000 | 2.0629 | 0.0000 | -2.7779 | 0.0000 |
| *Trend* | 0.0002 | 0.3120 | 0.0001 | 0.7560 | 0.0005 | 0.0880 |
| *National* | 0.5671 | 0.1240 | 0.6832 | 0.0970 | -1.1176 | 0.0530 |
| *Cross_EU* | -1.1965 | 0.0340 | -1.1272 | 0.0500 | -1.6912 | 0.0120 |
| *Extra_EU* | -0.2228 | 0.7710 | -0.1091 | 0.8900 | 0.3541 | 0.6850 |
| *ECMR_2004* | -1.0484 | 0.1370 | -0.4232 | 0.5690 | -1.7101 | 0.0930 |
| *Network* | 0.1995 | 0.7350 | 0.3486 | 0.5690 | 0.1978 | 0.7280 |
| *Same_Country* | -0.1772 | 0.6760 | -0.4050 | 0.3680 | -0.7581 | 0.1590 |
| *Vertical_Eff* | -0.7326 | 0.1240 | -0.9050 | 0.0650 | 0.5698 | 0.2800 |
| *No_Main_Comp* | 0.8185 | 0.0160 | 0.8707 | 0.0100 | 0.0047 | 0.9940 |
| *_cons* | -0.9263 | 0.1090 | -0.7546 | 0.1910 | 3.6229 | 0.0000 |
| *Observations* | 84 | | 78 | | 77 | |
| *Log Likelihood* | -30.738206 | | -28.687419 | | -16.832526 | |
| *Chi-Squared* | 53.26 | | 44.85 | | 34.12 | |
| *Significance level* | 0.0000 | | 0.0000 | | 0.0006 | |
| *Pseudo R2* | 0.4612 | | 0.4527 | | 0.6532 | |
| *Correct Predictions* | 0.8095 | | 0.7949 | | 0.8961 | |

*Notes:* The estimation of Weak Type I discrepancies is on the sub-sample of pro-competitive mergers, while the estimation of Type II discrepancies is on the sub-sample of anti-competitive mergers. The dependent variables are weak type1 (T1) and type2 (T2)

discrepancies. The $\tilde{\Pi}^{CG}$ variable is corrected for *p*, the predicted probability of the case being cleared obtained from a probit estimation on the full sample, where dependent variable is *Clear* and the exogenous variables are a constant, *Big_EU*, *Phase_II, Trend, National, Cross_EU, Extra_EU, ECMR_2004, Network*, *Same_Country* and *Vertical_Eff*.

**Table 6:** Marginal Effects

| **Dependent variable** | **WType I discrepancies** | | **WType I discrepancies** | | **Type II discrepancies** | |
|---|---|---|---|---|---|---|
| | | | Foreclosure Correction | | | |
| | **Coef.** | ***p*-Values** | **Coef.** | ***p*-Values** | **Coef.** | ***p*-Values** |
| $\tilde{\Pi}^{CG}$ | -3.48E-08 | 0.2280 | -5.22E-08 | 0.2440 | -1.95E-07 | 0.0000 |
| *Big_EU* | -0.1976 | 0.0240 | -0.2262 | 0.0120 | -0.0981 | 0.1580 |
| *Phase_II* | 0.4977 | 0.0000 | 0.4747 | 0.0000 | -0.4705 | 0.0000 |
| *Trend* | 0.0000 | 0.3000 | 0.0000 | 0.7550 | 0.0001 | 0.0600 |
| *National* | 0.1107 | 0.1470 | 0.1299 | 0.1320 | -0.1354 | 0.0630 |
| *Cross_EU* | -0.2250 | 0.0050 | -0.2104 | 0.0070 | -0.2100 | 0.0090 |
| *Extra_EU* | -0.0437 | 0.7650 | -0.0217 | 0.8880 | 0.0411 | 0.6740 |
| *ECMR_2004* | -0.2054 | 0.0850 | -0.0845 | 0.5430 | -0.2092 | 0.1090 |
| *Network* | 0.0407 | 0.7380 | 0.0730 | 0.5820 | 0.0233 | 0.7260 |
| *Same_Country* | -0.0349 | 0.6710 | -0.0784 | 0.3400 | -0.0974 | 0.1820 |
| *Vertical_Eff* | -0.1420 | 0.1030 | -0.1720 | 0.0360 | 0.0736 | 0.2220 |
| *No_Main_Comp* | 0.1694 | 0.0270 | 0.1821 | 0.0200 | 0.0006 | 0.9940 |

*Notes:* Coefficients represent average effects of partial derivative of $E[y] = F[\beta X]$. For the binominal (dummy) variables, coefficients represent the effect of discrete change of dummy variable from 0 to 1.

# 2. Regulating broadband access services - has the traditional model of entry and investment worked in Central Eastern Europe?

## 2.1. Introduction

The objective of EU policy making in the area of telecommunications has been to improve consumer outcomes by seeking to facilitate, amongst other things, competition between fixed line operators.

If consumers can choose between competing operators which offer fixed telecommunications services, then 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 build their own networks to compete with the fixed, copper based incumbents. Thus "inter-platform" competition[62] offers the greatest potential to roll back regulation and rely, to a greater extent, on competition to improve consumer outcomes[63].

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[64]. All else equal 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, in particular large parts of the access network, have been considered not to be replicable. This is primarily because it has been considered that it is not economically viable for new entrants to invest in the sunk costs involved with rolling-out a new access network, where an existing network is already present, due to the very significant economies of scale.

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

63 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.

64 See for example Cave (2006): "*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.*"

The regulatory policies to achieve the goal of competition, and mitigate the causes of market failure, have evolved over time. The development of a Europe wide regulatory policy in telecoms markets can be traced back to the 1998 telecommunications package. This package liberalised entry into telecoms markets in the European Community and set out rules on interconnection between networks. In implementing the law, national regulators in Western Europe (WE) countries required wholesale access products which enabled the reselling of the incumbent's voice services (using wholesale products such as carrier pre-selection (CPS)). While the aim was to improve competition, the results were rather limited. On the one hand, reselling of the incumbent's products allowed some competition as entrants could use CPS to build a customer base. However, these regulations proved insufficient to promote infrastructure based entry. Incumbent's market positions in the fixed voice segment remained strong.

The 2002 telecommunications package was an attempt to improve the efficacy of telecommunications regulation and enable a greater degree of infrastructure based competition. It developed regulation in a number of ways which reflected the LoI. First, it identified a list of wholesale markets where typically incumbents had significant market power. Second, it explicitly articulated that the purpose of ex ante regulation should be to address wholesale access bottlenecks, and that where ex ante regulation was sufficient to mitigate competition problems at the retail level, then regulation at this level could be withdrawn. In principle, as competition developed at each level of the value chain, it would become possible to withdraw ex ante regulation at that level, focusing it ever more upstream. This approach to regulation was thus intended to enable greater competition over those parts of the supply chain where competition was economically feasible.

However, as less of the supply chain is open to competition under access-based entry compared to infrastructure-based entry, the welfare gains associated with competition are likely to be more limited for access-based entry compared to platform-based entry

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 infrastructures. It proposed that rather than viewing access-based entry and platform based entry as substitute forms of competition, they should be seen as sequential, complementary steps.

A growing body of literature has attempted to empirically test whether the LoI model of competition applies to WE telecoms markets.[65] While the LoI has been studied from a number of perspectives, we are not aware of a study which has explicitly considered its

[65] For simplicity, we use the term "Western European countries" or "WE" for the following EU member states: 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".

application in Central Eastern European (CEE)[66] countries. This is an important question because there are significant differences between CEE and WE countries which may mean that a LoI may be expected to be relevant for WE but not in CEE.

As CEE states acceded to the European Union in 2004, and later in 2007 (Bulgaria and Romania), they adopted the 2002 telecommunications regulatory framework. However, compared with WE, differences in CEE countries' institutional frameworks, the structure of CEE countries' telecoms markets, and the fact that CEE countries were implementing access based regulation at a later point in time than WE countries may have led to differences in how competition would develop in CEE countries. In particular, the differing legacy telecommunications technologies, economic and demographic circumstances, and the way in which regulatory frameworks were implemented are likely to have affected the incentives of operators wanting to invest in broadband technologies, whether using an incumbent's network or their own infrastructure.

For these reasons, the regulatory policies which were appropriate for enabling competition in WE countries in the period of the early 2000s, for which a LoI may have been expected to be viable, may not have been appropriate for the CEE states at a later stage. The analysis in this paper is particularly relevant to this policy question.

The remainder of this paper is structured as follows:

- Section 2 discusses the theory of the LoI and the development of broadband competition in Europe;
- Section 3 provides a review of the literature on LoI;
- Section 4 presents our results; and
- Section 5 provides our conclusions and a discussion.

[66] 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.

## 2.2. The theory of the Ladder of Investment and its application in Europe

The sections below explain in more detail the conceptual framework of the LoI, the development of competition in European broadband markets, and the differences in WE and CEE countries which may have affected the development of competition in broadband markets in each group of countries.

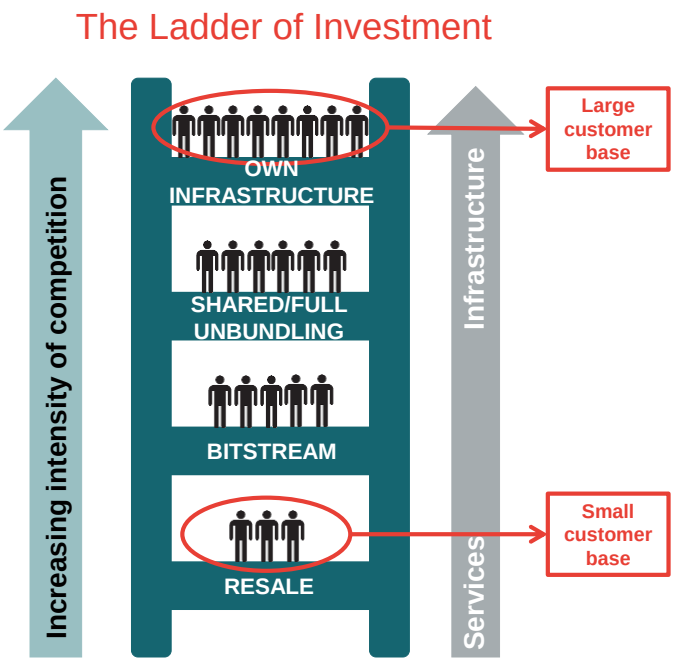
### 2.2.1. The conceptual framework of the LoI

The LoI envisages a phase of service based competition[67] 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 and brand; gain knowledge and experience; and 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".[68]

[67] We use the term "service-based" competition interchangeably with "access-based" competition.

[68] We use the terminology broadly consistent with Bacache et. al, (2014) 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: Authors adapted from ERG (05) 23*

While it is rare for regulators to directly refer to the LoI as underpinning their regulatory policies, the acceptance of the LoI framework by European telecommunications regulators is illustrated by the common position published by the European Regulators Group (ERG), a group representing the EU regulators in 2003. The ERG set out 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.[69]

[69] ERG (2003, p. 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*."

### 2.2.2. The evolution of competition in European broadband markets

Using data from the European Commission on the number of retail broadband connections in the 27 European Union countries between 2004 and 2011, it is clear that competition in CEE and WE countries has evolved in very different ways[70].

The data identifies whether each connection provided by a non-incumbent uses an incumbent's access service, such as resale of broadband, bitstream or unbundling of the local loop (ULL)[71]; or whether the entrant uses its own access infrastructure to provide broadband. 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% of fixed broadband connections.

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 recent years[72]. At the same time, while ULL's share is increasing over time, it has not grown above 3% of broadband connections. This does not appear to be consistent with the hypothesis that a partial LoI describes the development of competition in CEE countries. Even if there was any evidence of a partial LoI in CEE countries, the materiality of the effect would be very low given the low levels of ULL take-up.

These observations stand in contrast to the overall trends in WE countries. In these countries, bitstream[73] share of fixed broadband connections reached a peak in 2004 and has since fallen, whilst ULL has increased.

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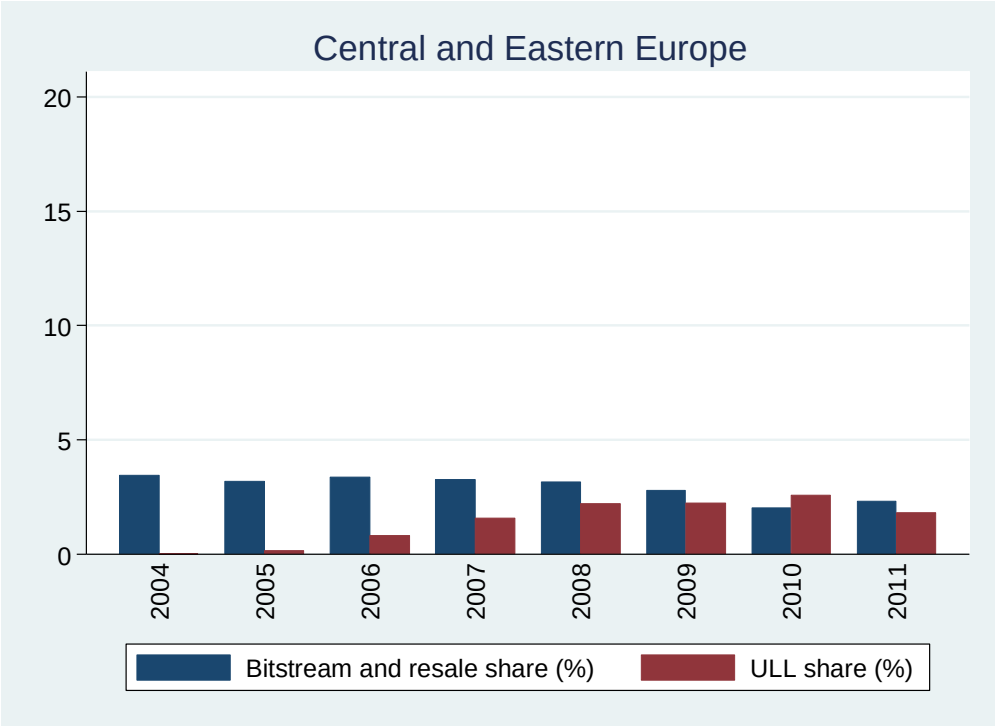
70 We have not extended the dataset to more recent years as the European Commission has started redacting a lot of the relevant data on the number of bitstream, ULL and inter-platform broadband connections by type (e.g. wholesale DSL) due to confidentiality reasons. Therefore, if we were to use more up-to-date, we would end up with a more unbalanced panel.

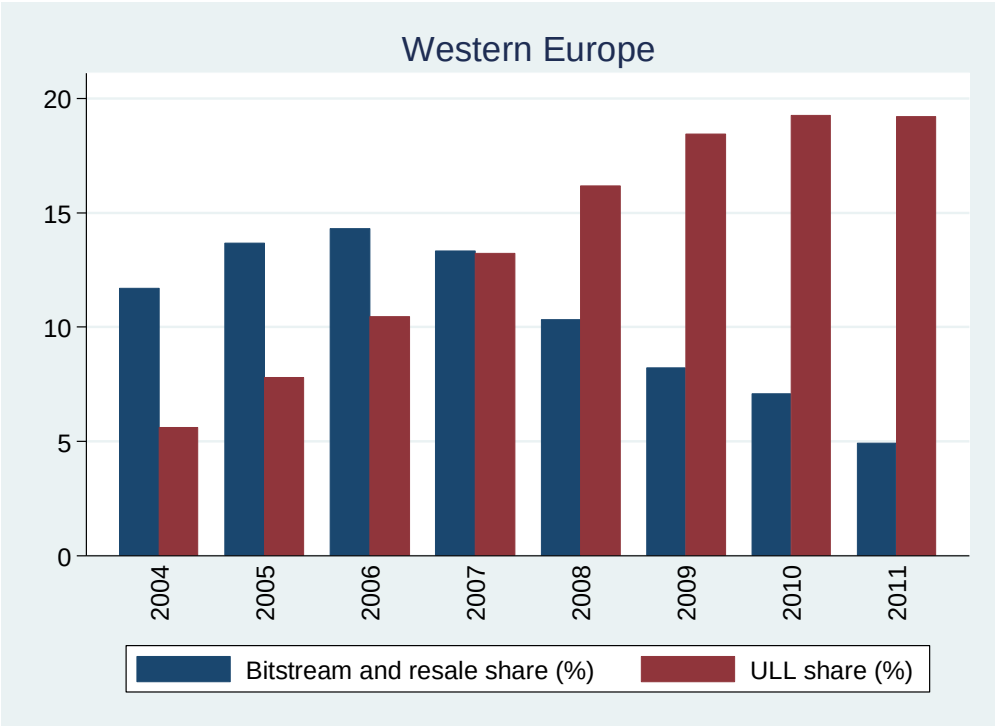
71 ULL is a wholesale access product through which a new entrant rents from the incumbent 'the last mile' of copper cable between the customer premises and a local exchange. ULL is more investment heavy product (compared with resale and bitstream), as it requires that a new entrant partly relies on its own network to deliver the broadband service. At the same time, ULL gives new entrants more control over the quality of service and increases their ability to differentiate the retail product from the incumbent.

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

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

**Figure 2:** Use of incumbent's wholesale broadband access products bitstream and resale and 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.

*Source: Authors' own analysis based on data from Progress reports on the Single European Electronic Communications Market, 2003 - 2010*[74]

Looking at the take up of broadband services based on alternative infrastructures, it is possible to 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%[75]. 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 leapfrog the incumbent's network and thereby by-pass the LoI.

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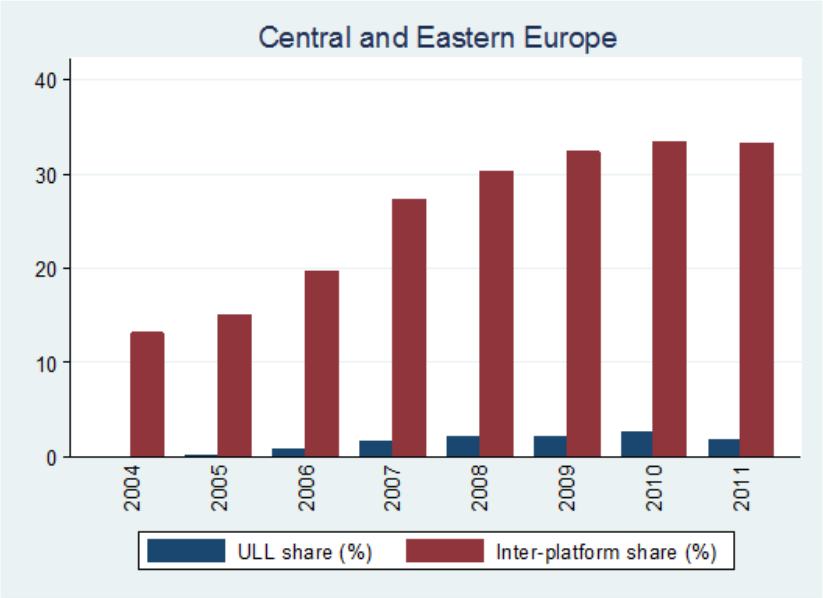
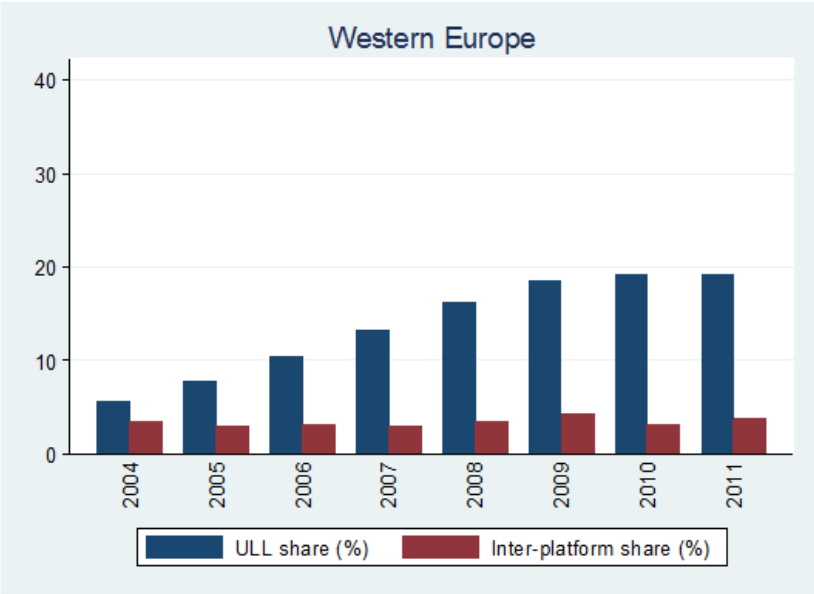
[74] **2010 data** in Table 1, http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=3501 or http://ec.europa.eu/information_society/newsroom/cf/document.cfm?action=display&doc_id=721; **2009 data** in Table 1 http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=3504; **2006 - 2008 data** in Figure 91, http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=3357: **2003 – 2005 data** in Table 1, http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=3414

[75] 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.

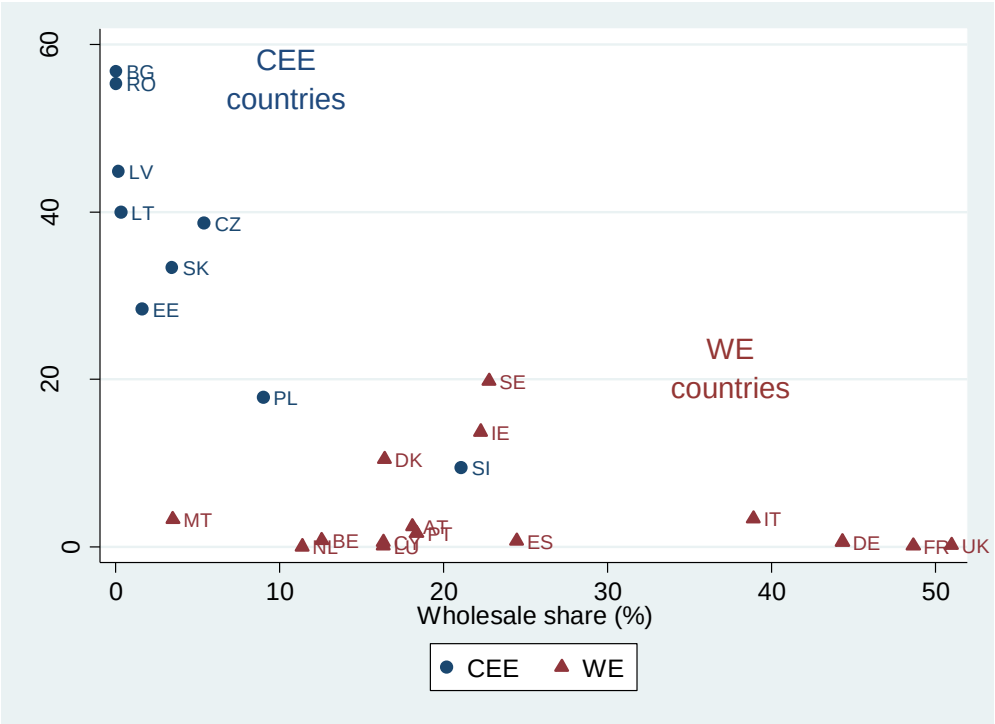
Inter-platform share refers to the share of new entrants' connections made with a non-DSL (excluding cable) technologies, i.e. based on own network infrastructure.

*Source: Authors' own analysis based on data from Progress reports on the Single European Electronic Communications Market, 2003 - 2010*

The differences in the development of broadband markets in WE and CEE countries are further illustrated in **Figure 4** below. In most CEE countries (with the exception of Slovenia) there is very low uptake of bitstream or ULL. In contrast, in most WE countries the share of connections using regulated access products is high, but "inter-platform" share is low. 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, as seen in **Figure 4** below. A more comprehensive overview of the use of different forms of broadband entry in the individual CEE countries is presented in **Figure 9** and **Figure 11** in **Annex 2** below.

**Figure 4:** Share of wholesale access products vs. infrastructure-based connections in the EU[76] (July 2009)



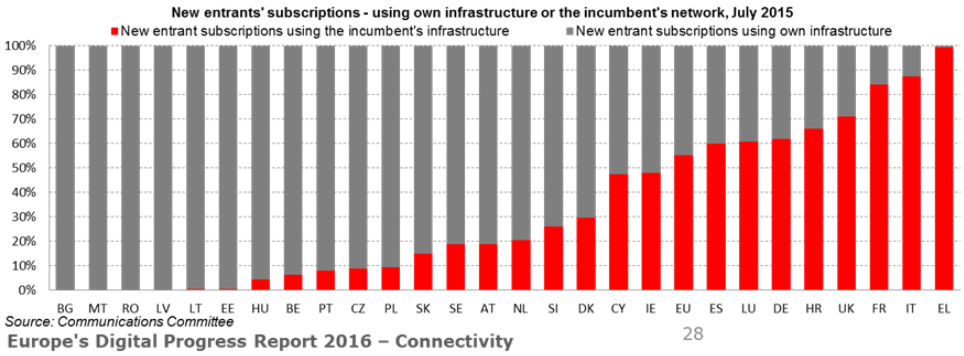

*Source: Authors' own analysis based on data from Progress reports on the Single European Electronic Communications Market, 2010*

According to the EC data from July 2009, in Bulgaria, Czech Republic, Estonia, Lithuania, Latvia, Romania and Slovakia, the share of broadband connections supplied by entrants using their own infrastructure is above 20% (and Poland is just under 20%), yet none of these countries have ever had a notable share of ULL. At the same time, Slovenia was the only CEE country in the sample where the share of alternative operators' broadband lines offered via the incumbent infrastructure was above 10%.

**Figure 5** below presents the more recent July 2015 data published by the Commission. In the majority of CEE countries new entrants now appear to rely solely on their own infrastructure. The only three countries where the share of new entrant lines using the incumbent network exceeds 10% were Croatia and Slovakia, in addition to Slovenia.

[76] There is missing data on the wholesale share in Hungary, Greece and Finland, which is why they are not shown in the figure.

**Figure 5:** New entrant's subscriptions – using own infrastructure or the incumbent's network, July 2015




*Source: Europe's Digital Progress Report 2016 - Connectivity*

This limited take up of wholesale access products observed in these countries does not seem to be fully consistent with the LoI theory

. In Slovakia, the recent increase in the number of wholesale access line appears to be driven by the investment of the major mobile provider Orange into bitstream access services, possibly in the attempt to off-load traffic from its mobile network in densely populated areas where it may not have its own fixed infrastructure.[77] There has been no take-up of ULL services despite ULL wholesale prices being among the lowest in the EU.[78]

In both Croatia and Slovenia, it appears that national regulatory authorities took significant steps to promote access based competition over the incumbent network, which has led to relatively high take of wholesale access products in comparison with other CEE countries. For instance, AKOS, the Slovenian regulator has intervened io 2005 to decrease ULL wholesale prices which stimulated take up of this wholesale product.[79] HAKOM, the Croatian regulator, belongs to one of the most active national telecommunications authorities, actively regulating wholesale as well as retail prices in all broadband related markets.[80] We understand that HAKOM has intervened continuously to make the access based entry more attractive for alternative operators, which contributed to a relative success of ULL in Croatia, see **Figure 6** below.

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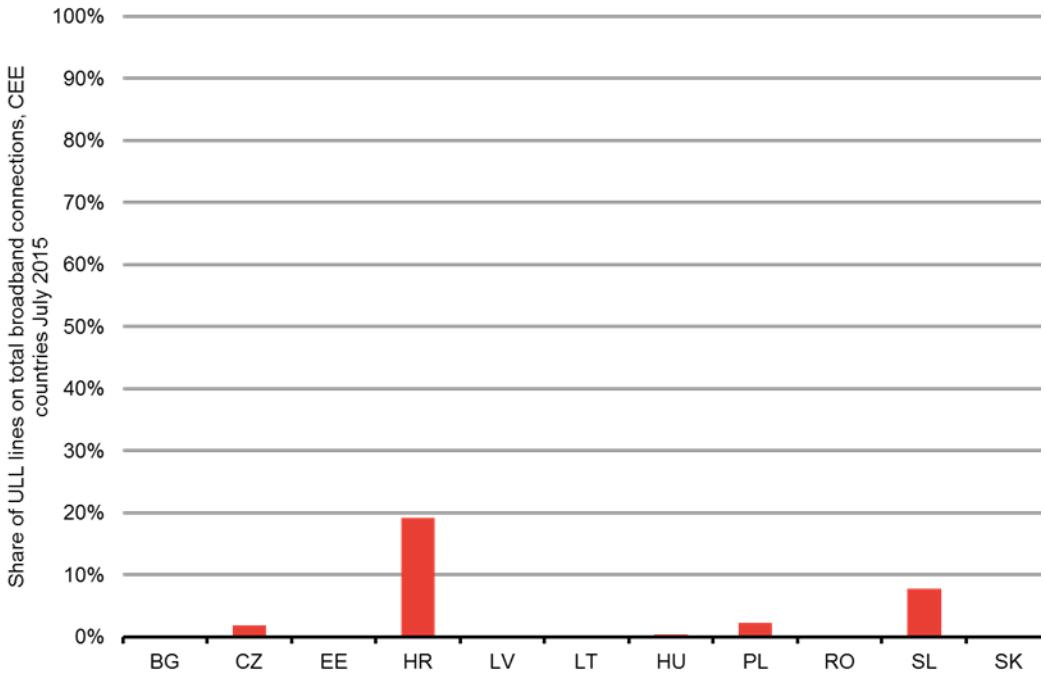
77 See for instance the online article from 7 March 2013 available at http://mobilmania.azet.sk/clanok/91164/orangeu-sa-nepaci-cenova-vojna-chce-investovat (in Slovak)

78 According to Europe's Digital Progress Report 2016 - Connectivity

79 See page 21/43, http://www.akos-rs.si/files/Telekomunikacije/Regulacija/Arhiv_analiz_in_odlocb/Trg_12/Analiza-trga-12-2007-arhiv.pdf

80 Seepage 144, http://www.cullen-international.com/asset/?location=/content/assets/research/studies/2011/11/final-report-4-annex-february-2014.pdf/final-report-4-annex-february-2014.pdf

**Figure 6:** Share of ULL lines on total broadband connections in the CEE countries, July 2015




*Source: Authors based on data from Europe's Digital Progress Report 2016 - Connectivity*

Nevertheless, these regulatory interventions seem to have only limited impact on the competitive dynamics in these two markets. The share of total broadband lines relying on ULL access is around 20% in Croatia and less than 10% in Slovenia. At the same time, Croatian broadband market seems to be largely dominated by the incumbent operator, which still controls more than 50% of the retail market share. Croatia also belongs among the worst performing EU countries when it comes to Next Generation Access (NGA) broadband, allowing speeds above 30 Mbps.[81] In Slovenia, the outcomes for consumers appear to be more positive, with the incumbent retail share below 40% and the availability of NGA technologies broadly in line with the EU average.[82] Nevertheless, these outcomes are likely to be driven by infrastructure (rather than access-based) competition, as more than 70% of new entrants' broadband lines are based on own networks, see **Figure 5** above.

In summary, only Croatia appears to be the country in the CEE region where there has been a relatively high take-up of ULL, which would be consistent with the short LoI. At the same time, this does not seem to have led to any significant investment into own networks by new entrants (full LoI).

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81 According to European Digital Progress Report 2016, available at http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=15807

82 According to European Digital Progress Report 2016, available at http://ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=15807

### 2.2.3. Differences in the application of the LoI between CEE and WE countries

As indicated above, competition has evolved differently in CEE and WE countries.[83] There are a number of key differences between CEE and WE countries which could explain why competition in telecoms networks would develop differently.[84]

First, the relative costs of rolling-out access infrastructure were significantly lower in CEE compared to WE countries. A large part of the costs of rolling-out a new access network is due to digging trenches. These costs are likely to be lower in CEE countries or avoided all together for a number of reasons. The cost of labour, the major part of the cost of network roll-out, is lower in the CEE region. For instance, the average monthly minimum wage in the CEE countries, which is likely to be a good proxy of the cost of low-skilled labour, was significantly below WE levels[85] [86]. Therefore, when making the choice of whether to invest in their own infrastructure or to invest in ULL or bitstream (where the investment costs related to a greater extent on equipment[87]), the cost differential between infrastructure investments and ULL investment was likely to be greater in CEE than in WE countries.

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 would be likely to lead to greater economies of scale available to CEE entrants compared to their WE counterparts, which would lead 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, lower administrative barriers for co-laying fibre in trenches dug for other purposes by local government, or greater reliance on aerial cabling[88]. This

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83 In some sense, the evolution of broadband markets in the CEE region may resemble more the US experience with a limited success of wholesale unbundling and more reliance on infrastructure competition, see Bauer (2005).

84 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.

85 Based on the information from Eurostat (earn_mw_cur) the average monthly minimum wage (in PPP terms) in CEE countries in 2004 was around EUR 300, which was only 30% of the average monthly minimum wage in WE countries of around EUR 940 (average covers only those countries for which information is available).

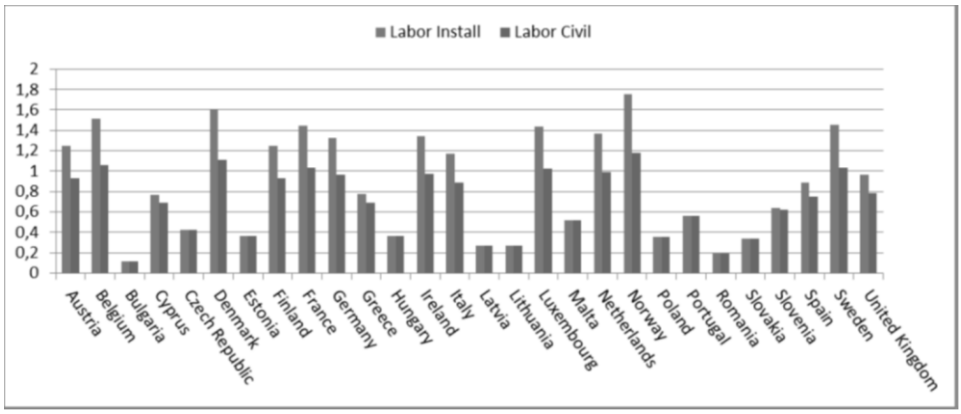
86 Average penetration of broadband was lower in CEE than WE countries, as would be expected given the lower income in the CEE countries. In our econometric analysis, we test this as an explanatory variable.

87 Equipment costs are likely to be determined on international markets and therefore there is likely to be little variation in equipment costs between WE and CEE countries.

88 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.

differential in the cost of network rollout between CEE and WE countries is further evidenced by more recent data from FTTH Council Europe, as shown in **Figure 7** below; see also Shorthall and Cave (2015).

**Figure 7:** The labour cost index for labour installation and civil engineering works




*Source: The Cost of Meeting Europe's Network Needs - FTTH Council Europe, July 2012 http://www.ftthcouncil.eu/documents/Reports/2012/Cost_Model_Report_Full_Version.pdf*

Second, entry via incumbent legacy access networks seems to have been less attractive for the alternative operators in CEE countries, compared to WE countries, potentially due the lower customer base reachable through the incumbents' network as well as their lower quality and coverage.

By the time new member states acceded to the EU in 2004, the average 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[89]. The low penetration of fixed services in CEE implied that the potential customer base reachable through incumbent's network was substantially lower than in WE countries.

In addition, the copper access networks of CEE incumbents were typically characterised by lower quality compared to their WE counterparts and this relatively poor quality 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 reasonable quality DSL broadband services to the majority of the population using its access network may have been limited in comparison to WE countries[90]. This further incentivised the entry via own infrastructure, allowing CEE entrants to exploit a greater differential in the quality of new infrastructure, compared to copper based products. This could in turn mean that the price differential between services offered on new fibre based infrastructures and copper was greater in CEE countries compared with WE countries.

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

90 A number of factors degrade the quality of broadband that can be offered on copper access networks. These include the longer length and small diameter of copper cables, the copper pair sharing among multiple end-users and the use of aluminium cables.

Third, by the time new member states acceded to the EU in 2004, there was already 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. Cable TV providers were investing significant amounts upgrading their cable networks to the DOCSIS 2.0, and later DOCSIS 3.0 standards, which offered far superior speeds than was possible using ADSL.

Fourth, mobile networks tended to play a greater role in CEE countries where the fixed legacy copper network was of lower quality and coverage was limited. This meant that in CEE countries the mobile networks provided the role of "universal voice coverage", unlike in WE countries. As mobile networks were upgraded to offer higher speed data services using EDGE or 3G technologies, there was less reliance on copper networks.

Fifth, the routes taken to the adoption of access regulation were different, as CEE countries did not introduce the 1998 Telecommunications Package, and instead only implemented the 2002 package. This meant that in CEE countries there tended not to be a phase characterised by competition using re-sale products such as CPS, unlike in WE countries which had enabled entrants to initially build scale and experience principally through selling voice and dial up internet products.

Other institutional factors could have played an important role. The likelihood of a successful access-based entry is likely to be relatively more dependent on the quality of regulation and competition law enforcement. The regulatory authorities in the CEE countries tended to be less experienced in implementing the EU regulatory framework than their WE counterparts, especially in the early years after the liberalisation. All else equal, this would likely imply that an alternative entrant trying to use an incumbent network to build their own business (and compete with the incumbent operator downstream) would have found it potentially more challenging in the CEE countries than WE countries where regulators had more experience with promoting access based competition. The two major EC competition law cases in the region (a refusal to supply case against Telekomunikacija Polska in Poland and a refusal to supply and margin squeeze case against Slovak Telekom in Slovakia[91]), as well as numerous abuse of dominance cases brought by local competition authorities, seem to provide evidence of regulatory failure during these early post-liberalisation periods in at least some of the CEE countries.

Measures of indicators which illustrate some of the factors above are set out in **Table 7** below. As discussed in more detail below, where data is available, we use these variables in our econometric analysis to control for country specific factors that are likely to impact the take-up of wholesale access products and therefore the presence of LoI in a given country.

[91] Case COMP/39.525 relating to a 2011 decision against Telekomunikacja Polska in Poland and Case COMP/39.523 relating to a 2015 decision against Slovak Telekom in Slovakia

**Table 7:** Comparison of selected market indicators in the CEE and WE (July 2004)

| | CEE countries | WE countries |
|---|---|---|
| Population Density | 85 | 223 |
| Wireline (fixed) penetration of households | 90% | 123% |
| Broadband penetration of households | 7% | 16% |
| Mobile penetration of households | 74% | 97% |
| GDP per capita PPP (euros) | 7,340 | 27,029 |
| Urbanisation | 46% | 40% |

*Data Sources: TeleGeography, Eurostat, European Commission. Note the table shows the unweighted average of each group of countries*

Therefore, by the time ULL became effectively available in CEE countries, entrants were already using alternative infrastructures to provide broadband services (as illustrated by the relatively high level of alternative infrastructures of CEE compared to WE countries in **Figure 3**).

These factors meant that even before accession to the EU, a LoI model of entry and expansion appeared less attractive in CEE countries compared with WE countries. On a prospective basis, new entrants in CEE countries were facing the risk that any investment into equipment used to provide broadband using ULL may not be fully recoverable in the future if this technology was likely to become obsolete, as the roll out of alternative infrastructure with superior characteristics was more likely to occur in CEE than WE countries.

All these factors are likely to have impacted the preferred mode of entry in CEE countries[92] and can help explain the differences in the competition patterns observed in the CEE region. Therefore, even where access based regulation was implemented, the significant differences in factors which affect the evolution of broadband meant that a LoI based approach to entry and expansion would not be optimal.

## 2.3. Literature review

[92] We note that there are other reasons which may have affected the take up of access services such as strategic behaviour by the incumbent (for example as exemplified by the Telefonica and Slovak Telekom cases). In our econometric analysis assessment, we test whether this is an explanatory variable.

There is a growing number of literature which examines the LoI from a theoretical perspective; and empirically testing its existence. Cambini and Jiang (2009) reviewed a comprehensive body of literature, both theoretical and empirical, on the effects of incentive and access regulation on broadband investment. We conduct a similar review of the literature, but with a narrower focus on access regulation and we include some more recent papers.

### 2.3.1. The theoretical foundations of the LoI theory

The LoI regulatory framework was first formally proposed by Cave and Vogelsang (2003) and was further formalised by Cave (2006). 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 the 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.

- 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 is set favourably for entrants as this creates an "opportunity cost" for operators considering investing in infrastructure. See, for instance, Crandall et al (2004). 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-up a 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, at least in theory, regulators can attempt to use regulatory tools to affect the balance between these two effects. An example would be to gradually increase wholesale access prices over time, as proposed by Cave (2006).

For the LoI theory to work, the planned increases in access prices must be credible. This point is highlighted by Avenali, Matteucci and Reverberi (2008). The authors consider a scenario where increasing access prices are needed to provide extra incentives for an entrant to invest. Using a dynamic model with two entrants entering the market in consecutive time periods, the authors illustrated that the regulator would be inclined to

alter the trajectory of prices after the entry of the earlier entrant, to encourage entry in the later period. A rational earlier entrant would then anticipate such a change of action and would no longer invest in the first place. Under such a scenario, the incentives provided by higher future access prices have disappeared.

Of course, the market conditions are also crucial to the relative sizes of the stepping stone effect and the replacement effect. As pointed out by Cave (2014), one cannot expect that the local loops will be fully replicated in less populated areas, especially if there are many local loop unbundlers. In other words, market size and concentration can significantly affect the investment decision of an entrant.

As concluded by Cambini and Jiang (2009), the findings in the theoretical literature are therefore ambiguous. Many authors thus turn to the analysis of data to gain more insight into the effects of access regulation.

### 2.3.2. 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 ULL had a negative impact on investments in access networks by incumbents and alternative operators. See, for example, Crandall et al (2004) or Hausman, J. and G. Sidak (2005) but note that it is standard in the literature to proxy the level of infrastructure-based investment by the number of infrastructure-based lines. 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 (2012) find that access regulation has a negative impact on investment by both incumbent and new entrants, and these results are in line with the findings reported by others, including Friederiszick et al. (2008).

From a slightly different perspective, Di Staso, Lupi and Manenti (2006) used panel data from 14 European countries and found that the price of local loop unbundling has a negative effect on broadband diffusion. In addition, the paper concludes that although both intra-platform and inter-platform competition stimulate broadband adoption, competition across different platforms is the main driver of broadband uptake. Denni & Gruber (2005) drew similar conclusions about the US data, namely that both intra-platform and inter-platform competition contribute to accelerating the speed of diffusion, but inter-platform competition has a much more important role in the long run.

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), 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) estimate the 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 (a higher number of regulated wholesale broadband lines as a percentage of the total number of retail broadband lines) 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. (2014) 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) 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 whether, and if so how, the LoI has worked in CEE countries. As explained below, there are significant differences in the development of competition in CEE and WE countries, which the existing empirical studies do not capture, partly due to the lack of sufficiently long data series from the CEE region.

## 2.4. Results and discussion

Section 2.2 explains that although the LoI described regulatory policy in both WE and CEE EU countries, there were significant differences in the market characteristics, and institutional frameworks which affected how the LoI was used. There is evidence that there are significant differences in competitive outcomes in WE and CEE countries, such that entrants in CEE countries have tended not to use incumbent's access products to compete.

In this section we test whether either a partial LoI or full LoI approach to entry and expansion explains competitive outcomes in CEE countries. We 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

### 2.4.1. Testing the hypothesis that either partial or full LoI explains competition in broadband markets in CEE countries

The graphical analysis presented in Section 0 suggests that neither the full LoI nor the partial LoI correctly describes how broadband competition has evolved in CEE countries. To give further support to this finding, in this section we explain the results of an econometric analysis to test for the partial and full LoI.

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 (2014) 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 socio-economic data, such as Eurostat. Further details of the data used is contained in an annexe, see **Table 11** and **Table 12**.

To assess whether the LoI hypothesis has worked in CEE, we decided to just use the CEE sample. An alternative approach would have been to also include WE countries to increase our sample size, and then include interaction terms between the explanatory variables and a CEE dummy. This would lead to a large number of explanatory variables. We decided against this approach because when using the full sample, we found that the interaction terms on many of the explanatory variables were significant[93]. This indicates that there is considerable difference in the drivers of ULL and new "inter-platform" lines[94] in WE compared to CEE.

[93] 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.

[94] For simplicity, we use term "new lines" when referring to non-DSL technologies used by alternative operators, as a proxy for inter-platform based broadband lines.

This means that any efficiency gain from having a larger sample is more than offset by heterogeneity bias.

As with Bacache et.al.'s (2014) approach, we assess the full LoI by looking at the impact of lagged values of ULL take up[95] 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 explanatory variables to include in the model (i.e. the appropriate number of lags for ULL lines for the full LoI model and number of lags for bitstream lines for the partial LoI model). Building a telecoms network takes time, which points towards the need to include multiple lags of the explanatory variable. This can be problematic as it can be difficult to disentangle the impact of individual lags given that there is multi-collinearity between the different lag terms, and there are limited degrees of freedom. To circumvent this problem for the bitstream and ULL explanatory variables in both the full and partial LOI models, we used the average number of lines over two lagged periods (i.e. a year since our data is bi-annual). As a robustness check, we also estimate the model by using the average number of lines in each of the past four time periods (i.e. two years) as the lagged ULL and bitstream explanatory variables to ensure that the model identifies the effect that lagged investment in ULL or bitstream has on investments "higher up the investment ladder". We have also estimated models with individual lags as separate regressors to ensure that our results are robust.

We control for a range of demand side and supply side drivers which determine demand for broadband. 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. For descriptive statistics of our data set, please see **Table 11** in the **Annex 2**.

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 penetration.[96] Taking logs more accurately reflects the relationship between the variables, and reduces the impact of outliers. This approach is in line with Bacache's et.al. (2014) approach.

We estimate the model using Ordinary Least Squares (OLS) with robust standard errors. We have also presented results when using a fixed effects estimator with robust standard errors.[97]

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

96 See the Annex 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.

97 However, we note that a fixed effects estimator only uses variation across time, which can render many of the coefficients insignificant.

We recognise that there may be unobserved differences between countries in the application of the regulatory framework, or the effectiveness of the regulatory oversight. However, we have also estimated fixed effects models. The fixed effects are equivalent to country-specific dummy variables, so the fixed effects should pick up any time-invariant differences in regulatory frameworks across countries.

The equation below shows how we have estimated the partial LoI, where the terms are described in **Table 12**.

$$\begin{aligned}\ln(ULL_{it}) = Constant + \ln(AvLagBit) + \ln(GDP\ pc_{it}) + density_{it} \\ + fixed\ penetration_{it} + \ln(householdnumbers)_{it} \\ + time\ trend + \varepsilon_{it}\end{aligned} \quad (9)$$

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

$$\begin{aligned}\ln(NL_{it}) = Constant + \ln(AvLagULL) + \ln(GDP\ pc_{it}) + density_{it} \\ + fixed\ penetration_{it} + \ln(householdnumbers)_{it} \\ + time\ trend + \varepsilon_{it}\end{aligned} \quad (10)$$

### 2.4.2. Econometric results

Our key result is that there does not appear to be any strong evidence of a partial or full LoI in CEE countries.

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 coefficient on the lag of bitstream. As the coefficient 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[98]. In other words, it does not appear that new entrants have used bitstream as a stepping stone to ULL in CEE countries.

[98] The coefficient 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 coefficients 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.

**Table 8:** Econometric results (partial LoI)

| | OLS | OLS | Fixed Effects | Fixed Effects |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| VARIABLES | ULL lines | ULL lines | ULL lines | ULL lines |
| **Bitstream lagged by 1 year** | **0.0195** | | **0.154** | |
| | (0.0489) | | (0.446) | |
| **Bitstream lagged by 2 years** | | **0.0300** | | **0.154** |
| | | (0.0579) | | (0.487) |
| Population Density | 0.000599*** | 0.000504** | 0.0162*** | 0.0192*** |
| | (0.000210) | (0.000230) | (0.00167) | (0.00267) |
| Log GDP per capita | 0.0453*** | 0.0722*** | -0.0223 | -0.00982 |
| | (0.0147) | (0.0200) | (0.0193) | (0.0199) |
| Log household numbers | -0.0185*** | -0.0133* | 0.0552 | 0.0147 |
| | (0.00656) | (0.00754) | (0.0422) | (0.0650) |
| Linear time trend | 0.00452*** | 0.00545*** | 0.00200** | 0.00205** |
| | (0.00103) | (0.00131) | (0.000883) | (0.000846) |
| Wireline penetration | -0.0181 | -0.00924 | -0.152** | -0.124*** |
| | (0.0219) | (0.0242) | (0.0500) | (0.0229) |
| Constant | -0.333** | -0.629*** | -1.435*** | -1.515*** |
| | (0.145) | (0.205) | (0.322) | (0.408) |
| Observations | 106 | 86 | 106 | 86 |
| R-squared | 0.531 | 0.608 | 0.693 | 0.646 |
| Number of countries | | | 10 | 10 |

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. Regression 5, uses the average ULL lag over 2 time periods (1 year), whereas regression 6 uses the average ULL lag over 4 time periods (2 years). Regressions 7 and 8 use the same specifications, but use a fixed effects model rather than OLS. In none of our specifications do we find a positive and significant coefficient on ULL[99]. 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.

**Table 9:** Econometric results (full LoI)

| | OLS | OLS | Fixed Effects | Fixed Effects |
|---|---|---|---|---|
| | (5) | (6) | (7) | (8) |
| VARIABLES | New lines | New lines | New lines | New lines |
| **ULL lagged by 1 year** | **-0.259** | | **-0.486** | |
| | (0.233) | | (0.343) | |
| **ULL lagged by 2 years** | | **-0.268** | | **-0.598** |
| | | (0.236) | | (0.518) |
| Population Density | -0.000551 | 0.000184 | 0.000859 | 0.000905 |
| | (0.000783) | (0.000716) | (0.00981) | (0.0127) |
| Log GDP per capita | -0.412*** | -0.456*** | 0.138 | 0.0756 |
| | (0.0437) | (0.0430) | (0.106) | (0.0869) |
| Log household numbers | -0.0651** | -0.0960*** | -0.0674 | 0.153 |
| | (0.0269) | (0.0243) | (0.245) | (0.259) |
| Linear time trend | 0.0205*** | 0.0172*** | 0.00668** | 0.00841** |
| | (0.00265) | (0.00319) | (0.00289) | (0.00329) |
| Wireline penetration | -0.0266 | -0.0857* | -0.200*** | -0.212** |
| | (0.0477) | (0.0449) | (0.0520) | (0.0669) |
| Constant | 4.373*** | 5.029*** | -0.507 | -1.574 |
| | (0.508) | (0.477) | (1.704) | (2.046) |
| Observations | 120 | 100 | 120 | 100 |
| R-squared | 0.737 | 0.764 | 0.556 | 0.584 |
| Number of countries | | | 10 | 10 |

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

[99] The coefficient 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 as an explanatory variable, since they may have an impact on both the uptake of ULL and new lines. This approach is similar to Bacache et.al. (2014) which also included ULL lines as a sensitivity check. 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.[100] We included broadband accesses based on cable technology in our definition of 'new lines'. We also tried using clustered standard errors in case the standard errors for a given country were correlated with each other[101]. The European Commission has conducted abuse of dominance investigations in Poland and Slovakia. Therefore, as a sensitivity test, we have excluded these two countries from our sample[102]. Under all of our robustness checks, our key result is that there is no evidence of a partial or full LoI in CEE countries.

As with Bacache et.al. (2014), we have also considered the use of a lagged dependent variable. We have not placed too much weight on our specifications that rely on the use of a lagged dependent variable, as for all types of estimators, there are econometric issues with using a lagged dependent variable. Since individual effects are present in our model, the OLS estimator of the coefficient on the lagged dependent variable will be biased upwards (omitted variable bias) while the fixed effects estimator may be biased downwards ("Nickell bias") due to our time series being too short. A consistent estimator would then be bounded by the OLS and FE estimator.

We have tried to implement the Arellano-Bond GMM estimator to correct for this bias.[103] A similar approach was also used by Bacache et.al. (2014). However, the GMM estimate of the coefficient of the lagged dependent variable in model (13) below is not between the OLS and Fixed Effects estimates. This suggests that the GMM model is not well specified. Since the Arellano-Bond estimator is best suited for models with a large cross-section dimension but a limited time horizon, the time series dimension of our data is too long while the cross-

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100 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 assuming a linear relationship. 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.

101 When using clustered standard errors, we would still be assuming that standard errors across different countries are uncorrelated with each other.

102 We recognise that there may be an omitted variable capturing the 'effectiveness of regulation' which would be likely be positively correlated with the take up of wholesale access services (bitstream and ULL), in which case the LoI coefficients in our model would underestimate the true LoI effect (if there is one).

103 In one of our specifications (regression 15) for the full ladder, we also tried including lagged bitstream (two year lag) as an instrument for lagged ULL (one year lag).

section dimension is too small. Our decision to focus on OLS and fixed effects[104] in our models with no lagged dependent variable is consistent with the conclusions reached by Chudik et.al. (2015), that *"The main advantage of the proposed CS-DL approach is that its small sample performance is often better compared to estimating unit-specific CS-ARDL specifications, under a variety of settings investigated in the Monte Carlo experiments when T is moderately large (30 < T < 100)"*. This is why, on balance, we do not consider that the positive coefficient in regression 13 should be considered as sufficient evidence that there is a partial LoI in CEE countries. There was no evidence of a full LoI in any of the regressions involving a Lagged Dependent Variable.

**Table 10:** Sensitivity testing the results

| | OLS | OLS | Fixed Effects | Fixed Effects | Arellano-Bond GMM | Arellano-Bond GMM | Arellano-Bond GMM |
|---|---|---|---|---|---|---|---|
| | (9) | (10) | (11) | (12) | (13) | (14) | (15) |
| | Partial LoI | Full LoI | Partial LoI | Full LoI | Partial LoI | Full LoI | Full LoI |
| VARIABLES | ULL lines | New lines | ULL | New lines | ULL lines | New lines | New lines |
| First lag of ULL share | 0.962*** | | 0.833*** | | 0.609*** | | |
| | (0.0420) | | (0.0847) | | (0.0538) | | |
| Bitstream lagged by 1 year | **0.00172** | | **0.235** | | **0.214*** ** | | |
| | (0.0167) | | (0.149) | | (0.0672) | | |
| Population Density | 5.18e-05 | 2.06e-06 | -0.00252* | -0.00859 | -0.00341* | -0.0120 | -0.0102 |
| | (4.26e-05) | (0.000383) | (0.00127) | (0.0110) | (0.00175) | (0.00907) | (0.00957) |
| Log GDP per capita | 0.00424* | -0.0443 | 0.00308 | 0.0755 | 0.0112 | 0.0733 | 0.0662 |
| | (0.00229) | (0.0326) | (0.00822) | (0.0928) | (0.00909) | (0.0581) | (0.0641) |
| Log household numbers | -0.00216 | -0.00635 | -0.0310 | 0.0341 | -0.0128 | -0.0104 | 0.124 |
| | (0.00145) | (0.0128) | (0.0437) | (0.199) | (0.0431) | (0.231) | (0.246) |
| Linear time trend | 0.000108 | 0.000832 | -8.75e-05 | 0.00281 | 7.77e-05 | 0.00297 | 0.00310 |
| | (0.000257) | (0.00225) | (0.000320) | (0.00217) | (0.000395) | (0.00244) | (0.00260) |
| Wireline penetration | 0.0211** | -0.0851* | -0.0196 | -0.0729 | -0.0271* | -0.0990 | -0.0106 |
| | (0.00959) | (0.0488) | (0.0184) | (0.0418) | (0.0156) | (0.0854) | (0.0974) |
| First lag of new lines share | | 0.856*** | | 0.338 | | 0.311*** | 0.326*** |
| | | (0.0582) | | (0.221) | | (0.0916) | (0.0989) |
| ULL lagged by 1 year | | **0.0367** | | **0.0620** | | **0.192** | **0.227** |
| | | (0.165) | | (0.257) | | (0.345) | (0.312) |
| Constant | -0.0398* | 0.551 | 0.437 | -0.00617 | 0.309 | 0.670 | -0.524 |
| | (0.0234) | (0.352) | (0.316) | (1.529) | (0.330) | (1.789) | (1.902) |
| Observations | 106 | 120 | 106 | 120 | 96 | 110 | 98 |
| R-squared | 0.949 | 0.896 | 0.885 | 0.418 | | | |
| Number of enc_country | | | 10 | 10 | 10 | 10 | 10 |

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

We recognise that visual results presented in **Figure 2** may potentially indicate some long-run relationship between lagged bitstream and ULL lines, which is not captured by our current econometric analysis which focuses on short-term effects only. One possible approach to address this would be to test for the existence of long-term relationship between bitstream and ULL within a dynamic model, but we consider this type of estimation would only make sense once the longer time series is available.

For final robustness checks, we have estimated models using bi-annual bitstream lags as regressors instead of the averaged lags, as well as models including 2-year bitstream lags. We have also estimated models using the logs of the number of lines for each variable. None of these models presents evidence that supports either the partial or the full LoI in the CEE.

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 accounting 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 Figure 8

[104] We have used Sargan-Hansen tests to compare the fixed effects and random effects models. For each pair, the test rejected the hypothesis that the coefficients of the random effect model are consistent.

and Figure **10** (WE countries) and Figure 9 and Figure 11 (CEE countries) in the annexe. It is difficult to fully account for this heterogeneity in econometric models, given the explanatory variables do not fully describe the heterogeneity between countries. 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. That said, these results should not be necessarily interpreted as competition in broadband markets not developing in the CEE countries. As discussed in Section 2.2.2 above, there has been a significant share of infrastructure-based entry in the CEE region and in many countries there appears to be healthy competition, despite the lack of the partial or full LoI.

## 2.5. Conclusion

The LoI has become a central tenet in regulatory policy in the telecommunications markets in the EU. It has underpinned the current regime of access based regulation to support iterative entry and expansion of broadband entrants in the EU.

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 the major cases in recent years (Case COMP/38.784 relating to a 2007 abuse of dominance decision against Telefonica in Spain, and Case COMP/39.525 relating to a 2011 decision against Telekomunikacja Polska in Poland and Case COMP/39.523 relating to a 2015 decision against Slovak Telekom in Slovakia) 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 the Telefonica Spain case, in paragraph 177, 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"*. In paragraph 604 of the Telekomunikacja Polska case, 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"* which resulted with the limited development of alternative infrastructures.

Despite the central role that LoI plays in the regulatory policy in the EU (and increasingly in other areas, such as competition policy), the empirical literature on the existence of LoI is mixed. The empirical literature on LoI to date tends to find some evidence of the entrants "climbing" lower rungs of the LoI to date in WE countries, but raises doubts on whether the entrants' use of incumbent operators' wholesale access products leads to greater inter-platform competition.

However, it is not obvious that the development of competition in broadband markets should follow a similar pattern in Spain and Poland or Slovakia. Consistent with the differences observe between WE and CEE countries in general, Spain on the one hand and

Poland or Slovakia on the other, 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, and we consider whether there is a positive relationship between the use of bitstream and ULL (partial LoI); and, or whether there is a positive relationship between bitstream or ULL access products and deployment of new infrastructure (full LoI).

Our paper adds to the literature by focusing specifically on the evidence from 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 by-passed 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 was ubiquitous, and of high quality; where penetration of fixed line services was high; and where costs of building an access networks are high.

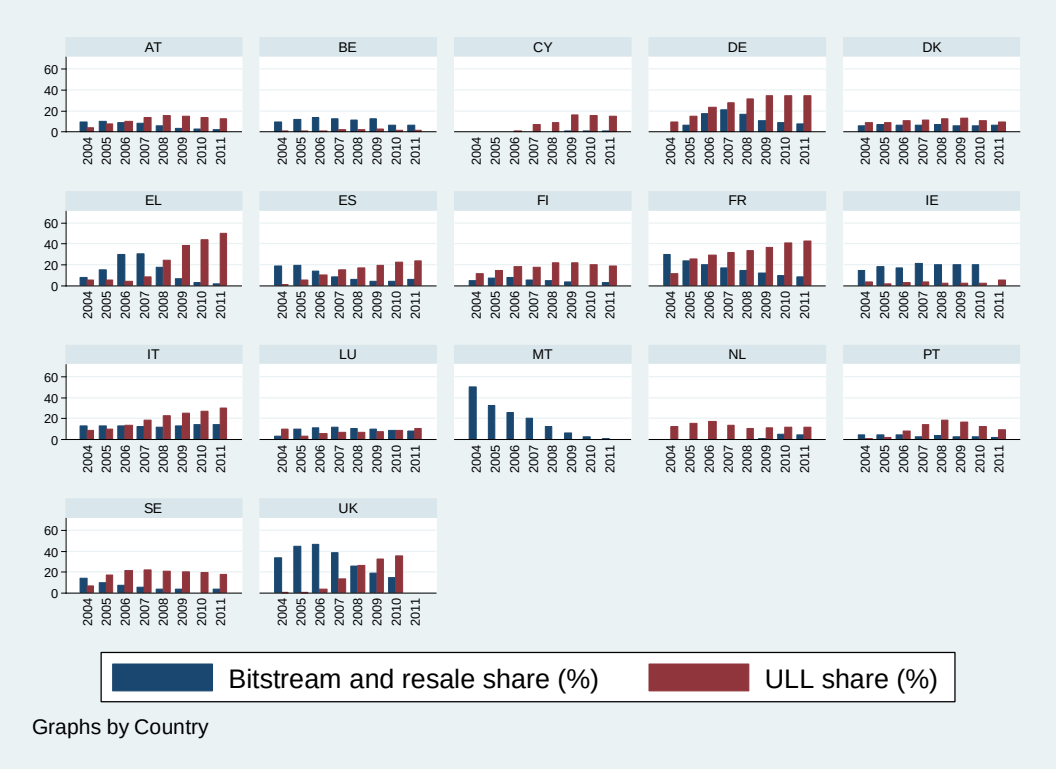
However, these conditions are not universal and in particular may not apply to CEE countries. Therefore, when implementing regulatory and competition policies in the CEE countries the authorities should take these specific factors into account and carefully consider the relevance and importance of the LoI concept for the past and future evolution of broadband markets in the CEE region.

## 2.6. Annex 2

Figures below provide more detail on the evolution of service-based and infrastructure-based broadband lines in individual countries of WE and CEE regions in the period covered by our statistical analysis 2004-2011. **Figure 8** and **Figure 9** present the share of bitstream (resale) and ULL on the total broadband lines in WE and CEE countries respectively.

**Figure 10** and **Figure 11** then contrast the share of ULL and own-infrastructure lines on total broadband lines across the two regions

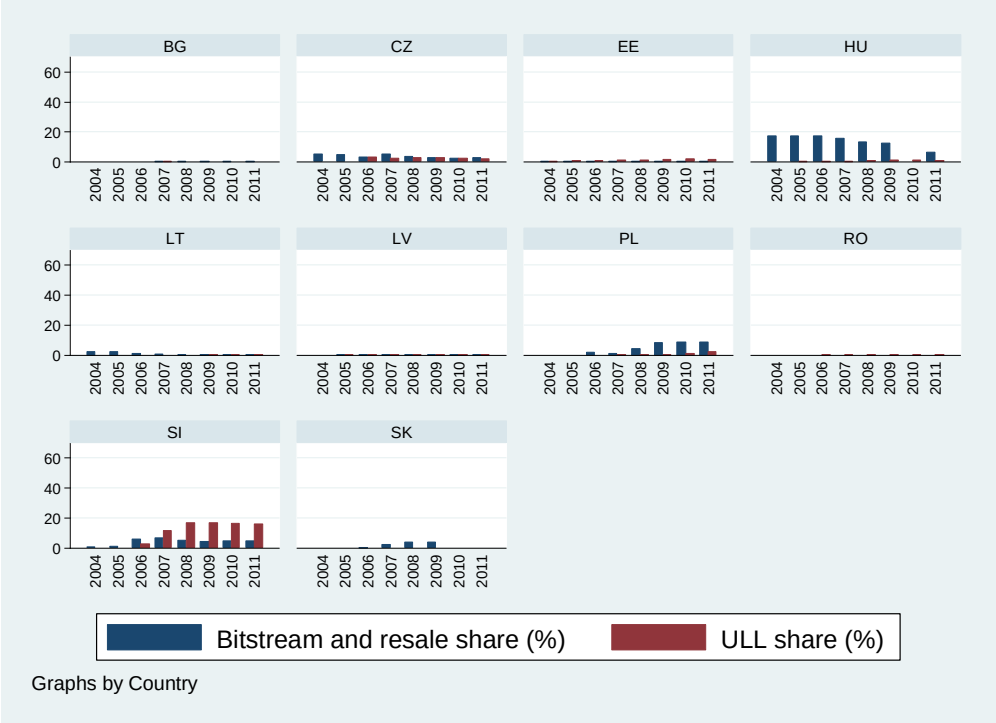
**Figure 8:** Evolution of wholesale access services 2004-2011 (WE countries)




*Source: Authors' own analysis based on data from Progress reports on the Single European Electronic Communications Market, 2003 - 2010*[105]

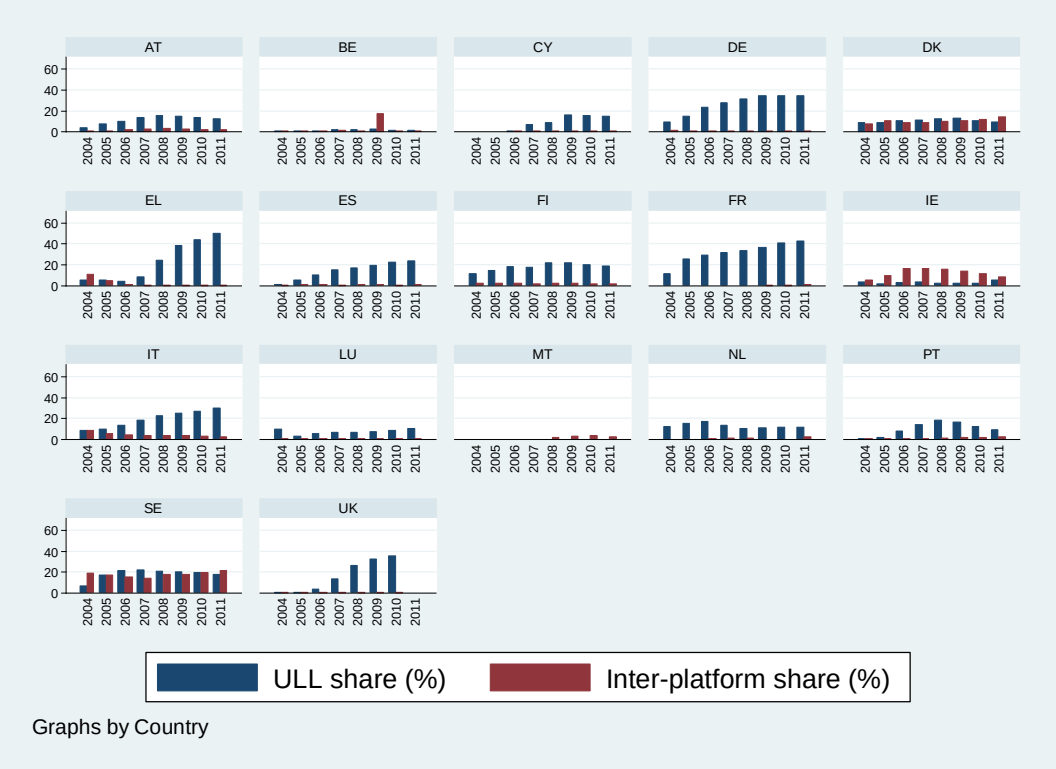
105 **2010 data** in Table 1, http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=3501 or http://ec.europa.eu/information_society/newsroom/cf/document.cfm?action=display&doc_id=721; **2009 data** in Table 1 http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=3504; **2006 - 2008 data** in Figure 91, http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=3357: **2003 – 2005 data** in Table 1, http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=3414

**Figure 9:** Evolution of wholesale access services 2004-2011 (CEE countries)



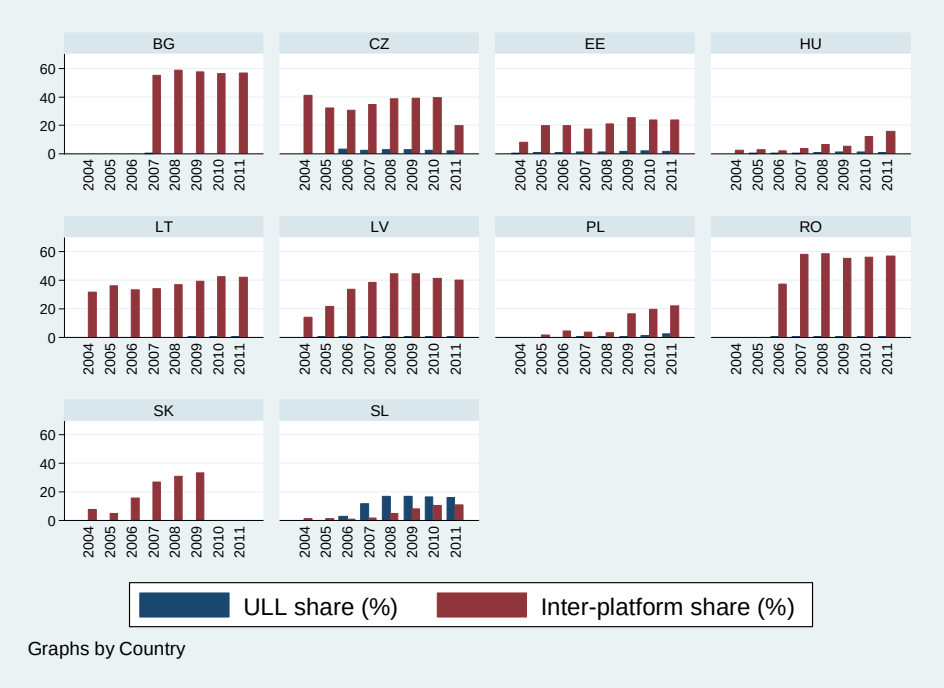

*Source: Authors' own analysis based on data from Progress reports on the Single European Electronic Communications Market, 2003 - 2010*

**Figure 10:** Share of ULL and infrastructure-based connections (WE countries)



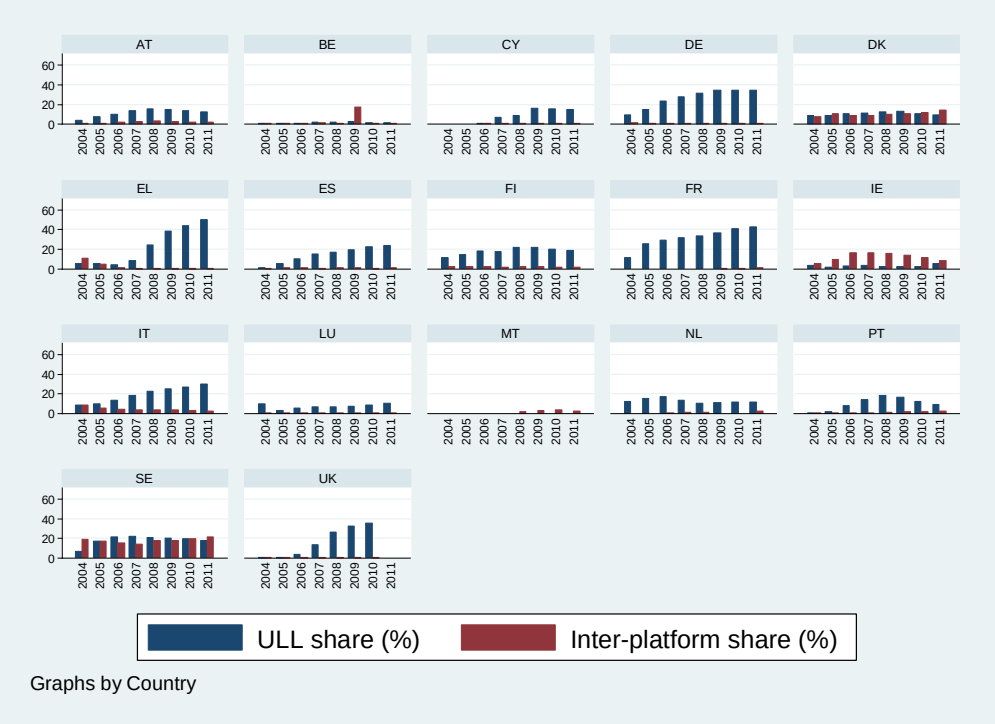

*Source: Authors' own analysis based on data from Progress reports on the Single European Electronic Communications Market, 2003 - 2010*

**Figure 11:** Share of ULL and infrastructure-based connections (CEE countries)




*Source: Authors' own analysis based on data from Progress reports on the Single European Electronic Communications Market, 2003 – 2010*

**Figure 12:** Share of ULL and infrastructure-based connections (WE countries)




*Source: Authors' own analysis based on data from Progress reports on the Single European Electronic Communications Market, 2003 - 2010*

**Table 11:** 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 |
| *Fixed line penetration* | 176 | 81% | 39% | 46% | 210% |

*Source: Authors' own analysis based on the data described in* ***Table 12***

**Table 12:** 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, Progress report on the Single European Electronic Communications Market, 2003 - 2010[106] |
| $\ln(NL_{it})$ | The natural log of new lines (excluding cable) in country i at time t | European Commission, Progress report on the Single European Electronic Communications Market, 2003 - 2010 |
| $\ln(AvLagULL)$ + | 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, Progress report on the Single European Electronic Communications Market, 2003 - 2010 |
| $\ln(AvLagBit)$ + | 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, Progress report on the Single European Electronic Communications Market, 2003 - 2010 |
| $\ln(GDP\ pc_{it})$ | The natural log of GDP per capita in country i at time t. | Eurostat, http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10_gdp&lang=en |
| $density_{it}$ | The population density in country i at time t. | United Nations, http://data.un.org/Data.aspx?d=PopDiv&f=variableID%3A14 |
| $wirelinepenetra$ | The fixed line penetration rate in country i at time t. | TeleGeography, https://www.telegeography.com/research-services/telegeography-report-database/ |
| $\ln(householdnu$ | The natural log of the number of households in country i at time t. | Eurostat, http://ec.europa.eu/eurostat/web/income-and-living-conditions/data/database# |
| $\varepsilon_{it}$ | Error term in country i at time t. | |

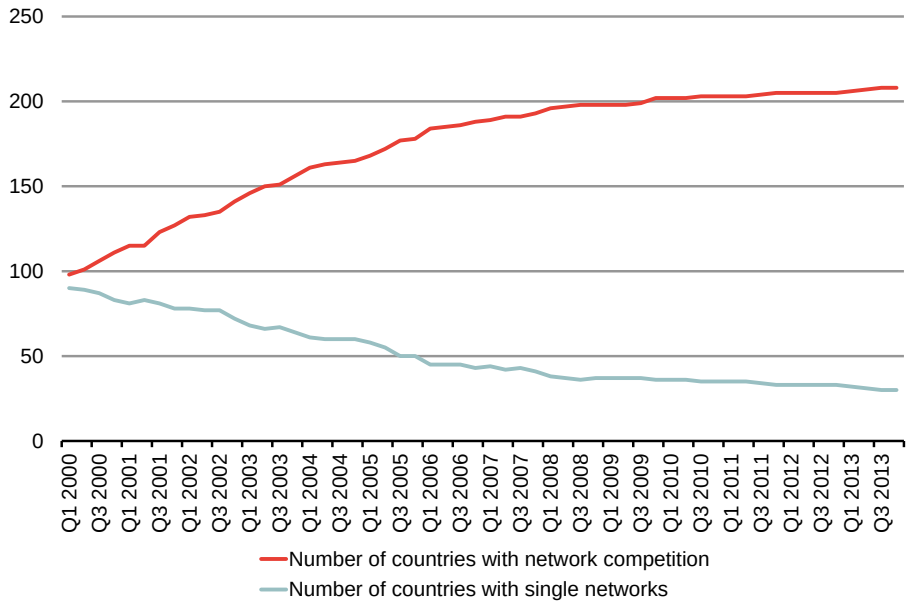
106 **2010 data** in Table 1, http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=3501 or http://ec.europa.eu/information_society/newsroom/cf/document.cfm?action=display&doc_id=721; **2009 data** in Table 1 http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=3504; **2006 - 2008 data** in Figure 91, http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=3357: **2003 – 2005 data** in Table 1, http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=3414

# 3. Network competition in mobile industry – what are costs and benefits of moving towards more service-based competition?

## 3.1. Introduction

In 2000, there were as many countries served by a single mobile network as by network competition. Today, only 30 countries[107], representing less than 3% of the world's population, are served by a single network. This strong shift towards network competition is shown in the following graph.

**Figure 13.** Number of countries with network competition and single networks




**Source: GSMA intelligence database**

This increase in network competition has arisen partly due to the actions of regulators, who have a) at times reserved spectrum for new entrants b) encouraged inter-operability between networks and c) re-allocated more spectrum from other industries such as broadcasting to mobile. During the past 15 years the extension of network competition has

[107] Andorra, Bahamas, Cocos (Keeling) Islands, Comoros, Cook Islands, Cuba, Diego Garcia, Djibouti, Eritrea, Ethiopia, Falkland Islands, Greenland, Kiribati, North Korea, Marshall Islands, Micronesia, Monaco, Montserrat, Myanmar, Nauru, New Caledonia, Niue, Norfolk Island, Saint Pierre and Miquelon, San Marino, Sao Tomé and Principe, Svalbard and Jan Mayen, Swaziland, Tuvalu and Åland Islands.

produced unprecedented growth and innovation in mobile services, particularly in developing countries. The number of mobile users increased almost 20 times, from 0.13 billion to 2.5 billion. Mobile services became widespread, with more than 90 per cent of the world's population now having mobile coverage[108] and almost half of the world's population covered by mobile broadband (3G) networks[109]. At the same time, the cost of mobile services has halved in developing countries, while the average price paid has fallen by more than 80%, while usage[110] has increased by almost 120%. Turnover in the mobile sector has grown to represent 1.5% of global Gross Domestic Product (GDP), supported by an investment in mobile networks of almost $2 trillion since 2002.

Arguing about the optimal number of network operators in the mobile industry is not new. This debate has been present since the liberalisation of telecommunication industries in the EU and early days of mobile competition in the 90s and more recently in the context of mergers and the setting of spectrum caps in 4G auctions.[111] However, the novelty now is that some regulators and governments are considering implementing some form of a Single Wholesale Network (SWN) to deliver next generation mobile services (4G). For example, in 2014 there were SWN proposals at various stages of development in Mexico[112], Kenya[113], South Africa[114], Rwanda[115] and Russia[116]. This could represent a radical departure from the competing networks approach to the development of mobile services which has been favoured by policymakers around the world for the past 30 years.

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108 Based on GSMA Intelligence database available at http://www.gsma.com/aboutus/gsm-technology/gsm

109 Based on International Telecommunications Union (http://www.itu.int/net/pressoffice/press_releases/2013/41.aspx#.U33cLH9wamQ, retrieved on June 20, 2014)

110 Minutes of use per connection (GSMA Intelligence)

111 For more general discussion on the benefits of privatisation and competition in network industries and telecommunications sector in particular, please see Vickers and Yarrow (1990), Li and Xu (2004) and Gasmi et. al (2011).

112 A summary of the latest proposals for Mexico available at https://www.detecon.com/en/Publications/open-access-mobile-wholesale-netco

113 Kenya National Broadband Policy National Spectrum Policy Guidelines for Spectrum Policy (see http://www.information.go.ke/wp-content/uploads/2014/03/DraftSpectructionPolicy.pdf)

114 A summary of the latest proposals for South Africa available at http://www.bmi-t.co.za/content/open-access-wireless-network-suitable-south-africa

115 Draft National Broadband Policy for Rwanda (see http://www.myict.gov.rw/fileadmin/Documents/DRAFT_NATIONAL_BROADBAND_POLICY_FOR_RWANDA_7.22.13.doc)

116 Maravedis-bwa article "russia revives notion of shared 4g network" (see http://www.maravedis-bwa.com/templateemail/newsletters/071613/russia-revives-notion-of-shared-4g-network.html)

The exact details of the SWN proposals vary across countries. However, a common theme is that the SWN would typically have a competitive edge on the existing networks, for instance by having access to all 700 megahertz (MHz) spectrum, and that the government would have some ownership of the SWN. As a result, the SWN would be expected to remove competition at the wholesale-level, but there would continue to be retail competition. Other operators, including existing network operators, would have to largely rely on wholesale agreements with the SWN to offer next generation mobile services to its retail customers.

We understand that under existing SWN proposals, there is likely to be a period of co-existence between SWN used to deploy next generation mobile technologies (i.e. 4G and 5G) and existing mobile networks used primarily to serve the existing customer base with legacy mobile services (i.e. 2G and 3G). We believe that this would not be a sustainable outcome in the long-run, as under the co-existence scenario i) the SWN would not be able to benefit from economies of scale at the network level and achieve efficiencies from removing network duplication; and ii) the existing network competition would be distorted by a presence of a special network operators (likely government owned and under some form of preferential treatment).

Therefore, any co-existence period will inevitably result in one of the two outcomes: either the 'true' SWN will dominate and there will be only one mobile network over which all operators provide their services based on all available technologies, or the SWN would fail and network competition will continue with each operator providing end users with mobile service over its own infrastructure. Our paper therefore focuses on evaluating the potential long-term outcomes of the first scenario, i.e. assessing how market outcomes under the 'true' SWN would look like compared to pure network competition (ignoring the interim co-existence period).

SWNs have been proposed for a variety of reasons, with the exact rationale depending on the specific country in question.[117] However, the reasons can be split into three broad categories. First, there have been concerns that competing operators will not deliver enough or fast enough network coverage, particularly in rural areas. Second, some parties have argued that network competition leads to unnecessary duplication of costs and spectrum fragmentation. Third, in cases where authorities consider that network competition is not working, they view the combination of an SWN and many mobile virtual network operators (MVNOs) as a way of increasing competition.

A key question is whether these concerns are valid and how an SWN would perform relative to a counterfactual of network competition. There have been no SWNs to date in the mobile industry, so it is difficult to test directly how an SWN would perform. There have been some examples of national SWNs in the fixed sector, such as in Australia, Singapore and New Zealand. However, fixed networks exhibit greater economies of scale than the mobile sector, so it is not possible to accurately predict the success of SWNs in the mobile sector based on SWNs in the fixed sector. The SWNs in the fixed sector do nonetheless highlight some of the challenges in setting up and running an SWN. For example, the SWN in Australia was on the

[117] See specific examples in footnotes 6 to 10 above.

verge of collapsing at one point. If an SWN were to fail, then this could cause serious consumer detriment, given the lack of alternative network operators that consumers could switch to.

In addition, in many countries there have been examples of local or regional fixed wholesale access networks, typically deployed to deliver next generation broadband service primarily to more remote rural areas (e.g. Sweden or Denmark).[118] [119] However, these examples are less relevant for evaluating the expected impacts of national mobile SWNs. This is because there is a strong economic rationale for building a single wholesale network in areas where having only one network provider may be the most efficient way of delivering mobile service to end customers. The case for a single network is much less clear in areas where multiple network roll-out may make commercial sense and where long term benefits from competition at the network level (in terms of innovation and investment) may outweigh any short-term static inefficiencies (in terms of network duplication).

As shown by the figure above, there have been several countries that have relied on only one vertically-integrated mobile operator, either government owned or privately owned. Therefore, in this paper we compare the outcomes under network competition relative to single networks, as a proxy for SWNs. While they recognise this is not a perfect equivalent to an SWN, because the SWN will introduce retail competition via network access to the SWN, it can be used as a 'second-best' approximation to assess the expected long-term effects of moving away from network competition to an SWN model. Ideally, we would want to compare consumer outcomes in (a) countries with network competition (i.e. competition between multiple vertically integrated network operators) with (b) outcomes in countries with a single wholesale network, with competing retail providers and (c) outcomes in countries with a single (vertically integrated) network provider.

The lack of data on (b) implies that it is not possible to do this comparison. We have also considered the lessons provided by countries with more developed service-based competition in the form of MVNOs. These countries are likely to be a poor proxy for (b). This is mainly because countries with a high number of MVNOs tend to be countries where network competition is already present and is likely working (with multiple network operators competing aggressively for both retail and wholesale customers), therefore of a limited use for measuring the impact of a scenario in which there may be a strong retail competition, but no competition at the wholesale level, i.e. the SWN. Nevertheless, it is still useful to compare (a) with (c), for which they have significant data, primarily because

- a significant proportion of costs for mobile operators are incurred at the network-level rather than at the retail-level and the wholesale network services account for more than 50% of the value added of mobile services; and

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118 FTTH Council Europe, 2013, "Sweden: a showcase for rural FTTH", http://www.ftthcouncil.eu/documents/Opinions/2013/Rural_FTTH_Nordics_Final.pdf

119 OECD, 2015, "Development of High-speed Networks and the Role of Municipal Networks" http://oecdinsights.org/2015/11/26/municipal-networks-contribute-to-increased-broadband-coverage/

- most of the innovation and technology adoption that has driven the very significant improvements in efficiency happens at the 'wholesale network' level.

Therefore, our analysis still provides a useful insight into the expected performance of SWNs compared to network competition model.

We assess the impact of network competition on network coverage, take-up and innovation. We find that network competition delivers superior outcomes to single networks. This paper represents a significant contribution to the literature. To our best knowledge, no other papers have considered the impact of network competition compared to single networks on outcomes such as coverage[120]. This may be partly because it is difficult to get data on coverage, particularly at the country-level rather than at the operator-level. Although there has been much discussion around the optimal number of mobile network operators, there has been much less consideration of whether network competition should be preferred to single networks.

The policy implications of the results are also significant, as they imply that regulators and governments could be taking a considerable risk by implementing SWNs in the mobile sector, which could lead to worse outcome for end users in terms of availability and quality of mobile services. Moreover, once an SWN has been established, it will be difficult and time consuming to then return back to network competition.

The rest of this paper is structured as follows:

- In section 3.2, we discuss the expected impact of network competition on a range of outcomes;
- In section0, we provide an overview of existing relevant empirical literature;
- In section 3.5, we explain our empirical approach for assessing the impact of network competition;
- In section 3.6, we present our results and key findings; and
- In section 3.7, we conclude and consider the policy implications of our main results.

## 3.2. Theory: the impact of network competition

Proponents of SWNs argue that network competition results in lower network coverage, particularly in rural areas.[121] This is because there are likely to be some areas where it is only profitable for one operator to roll-out its network. If multiple operators roll-out their

[120] Gruber (2001), Gebreab (2002), Gruber and Verboven (2001), and Kalba (2003) all assessed the impact of the level competition on mobile take-up. However, they did not explicitly consider the impact of single network.

[121] See for instance an online article "Stuck in the slow lane: Why Kenya's public 4G network isn't up to speed" available at http://www.zdnet.com/article/stuck-in-the-slow-lane-why-kenyas-public-4g-network-isnt-up-to-speed/

networks to these areas, then the operators may not have sufficient retail customers to be able to cover their costs. There are a number of authors who analysed from a theoretical perspective how outcomes like penetration, coverage and prices are affected by the level of competition and measures that dampen price competition like uniform pricing.

For instance, Götz (2013) examines the effect of the regulatory regime on both penetration and coverage of fixed broadband networks. One of the key findings is that as long as firms can price discriminate across regions, i.e. firms are unregulated, the monopoly scenario yields the same coverage as the scenario of network-based competition. Using an approach similar to Valletti, Barros, and Hoernig (2002), the paper highlights the importance of population density for whether firms invest to provide internet access. The analysis reveals a trade-off between coverage and penetration under regulated uniform retail and wholesale access prices, i.e. when firms are regulated. Higher prices lead to wide coverage but low penetration – there is a trade-off between setting high prices which allow the monopoly to earn a high return and make it attractive to roll out in rural areas, and low prices which increase penetration across all regions.

For Valletti et al. and Gotz, the result of this trade-off is that price discrimination should lead to higher coverage both under a monopoly and network-based competition, and that unregulated competition should not result in higher coverage. But overall penetration might be higher under facilities based competition than under a monopoly due to lower prices in regions where several firms are present. If firms are required to charge a single price across all markets/regions, then this will lower the degree of price competition in urban areas. This is because without uniform pricing firms could set low prices in competitive areas where local average costs are low due to high population density. But with uniform pricing the relevant cost for breaking even is the average cost across all the markets that a firm serves. So the incumbent, who by assumption is the one serving all high cost regions that have a regional monopoly, would not be able to sustain the competitive prices in urban areas. As a result the incumbent might find it preferable to leave some of the competitive urban areas in order to keep prices high in areas where it is the monopolist.

Foros and Kind (2003) show that network competition may not lead to increases in welfare if there is a uniform pricing requirement, instead finding that coverage and welfare improvements are far more likely under non-uniform pricing. Indeed, they show that regional price discrimination leads to a similar level of coverage compared to the coverage achieved under a social planner regardless of the level of competition. As such, the introduction of competition is focused on delivering higher welfare and penetration through lower prices.

Therefore, it appears that the theoretical literature broadly supports the argument of SWN proponents that a single network could lead to increased coverage in a given country, vis-à-vis a counterfactual with multiple competing networks. As discussed below, this is not necessarily consistent with the empirical findings.

## 3.3. Literature review – existing empirical evidence

We have reviewed the existing literature on the impact of competition on coverage, take-up and investment in the telecommunications sector. The available evidence indicates that there is a positive link between competition, service diffusion and investment. None of these studies, however, directly looks at the performance of mobile markets in countries with a single mobile network compared with countries in which there is network competition. Moreover, the global data set used provides a unique insight into the performance of single mobile networks.

The relationship between competition and performance of telecommunications markets has received a significant attention in the academic literature over the last two decades, in particular following the liberalisation of mobile market in a number of countries.

The primary focus of these studies seems to be the link between competition and the diffusion of telecommunications services. Early contributions include Gruber and Verboven (2001a,b), Gruber (2001) and Wallsten (2001). Considering a sample of European countries, Gruber and Verboven (2001a) find a significant impact on the diffusion process by the introduction of competition. Gruber (2001) focuses the analysis on Central and Eastern European countries. The results show that the speed of diffusion increases with the number of firms in the market. The analysis also shows that simultaneous entry is more effective than sequential entry in accelerating the diffusion speed. Gruber and Verboven (2001b) extend the analysis to cover a wider geographic landscape. The paper finds that the introduction of second entry licenses had a significant impact on the diffusion of mobile services. Wallsten (2001), on the other hand, explores the effects of privatisation, competition, and regulation on telecommunications performance, considering evidence from 30 African and Latin American countries in the period 1984-1997. The analysis reveals that competition – measured by mobile operators not owned by the incumbent – is correlated with increases in per capita number of mainlines, payphones, and connection capacity, and with decreases in the prices of local calls.

More recent studies include Rossotto et al. (2005), Rouvinen (2006) and Li and Lyons (2012). Rossotto et al. (2005) analyse the impact of opening up telecommunications to competition in the Middle East and North Africa (MENA) region on the sector's performance and on the participation of the region in the World economy. Their empirical research shows that increased market competition boosts demand for fixed and mobile telephone services by lowering prices to users. Their estimates also suggest that greater competition is associated with increased productivity of labour in telecommunications as measured by revenues per employee. Using a wide data set covering a large number of countries, Rouvinen (2006) examines the diffusion process of digital mobile telephony in developed and developing countries. Overall, the analysis finds that competition promotes the diffusion process. Li and Lyons (2012) use a sample of 30 countries over the period 1991-2006 to assess the

determinants affecting the speed of mobile penetration. They find that network competition results in faster diffusion rates as compared with a monopoly.

There is also wide research looking at the relationship between competition and penetration of telecommunication services, particularly in the context of broadband diffusion. For example, Fink et al. (2002) consider a panel data set of developing countries in Africa, Asia, the Middle East, Latin America and the Caribbean covering the period 1985-99.They investigate how competition in the local market segment affects performance measured as labour productivity and number of mainlines. They find that both privatisation and competition lead to significant improvements in performance.

Focused on broadband penetration and using data from a sample of 20 Organisation for Economic Co-operation and Development (OECD) countries, Bouckaert et al. (2010) find that competition between platforms has been the main driver of broadband penetration, whereas service-based within platform competition appears as an impediment to penetration. Similarly, using quarterly data from the fourth quarter of 2000 to the first quarter of 2004 for 16 Western European countries, Höffler (2007) concludes that without cable competition, the number of broadband subscribers would have been approximately 10 percent lower. Other articles that have found similar results are Denni and Gruber (2006), Distaso et al. (2006), and Aron and Burnstein (2003).

Also in the context of broadband communications, a number of studies have emerged investigating how competition affects prices and quality. While this is still a nascent literature, existing research shows that competition between network operators have a positive impact on quality, as measured by broadband speed. This is found in Nardotto et al. (2013), Smith et al. (2013). The latter paper further finds that competition between networks leads to lower prices.

In the existing literature, there has also been much debate about the impact of market concentration on innovation. On one side of the debate is the Schumpeter view, which considers that high market concentration increases innovation, as it is easier to reap the return on investments with higher concentration and there are economies of scale in research and development (R&D). On the other side of the debate is the Arrow view, which states that lower market concentration increases the incentive to innovate as firms will want to get ahead of their rivals and thereby steal their customers. This is also known as the replacement effect. With lower market concentration, there will also be more firms who are searching for innovations and this also increases the probability of an innovation being discovered; Geroski (1990).

The overall impact of market concentration on innovation therefore depends on whether the Schumpeter or replacement effect dominates. In an attempt to consider both effects and reconcile exiting mixed evidence, the seminal paper by Aghion et. al. (2005) built a dynamic model where current technological leaders and their followers in any industry can innovate, and innovations by leaders and followers all occur step-by-step. Their key result is the identification of an inverse-U shape relationship between competition and investment,

which is supported by their empirical analysis using panel data from UK companies, covering the period 1968 to 1996.[122]

There are a number of studies which have empirically assessed the relationship between competition and investment in the mobile industry, in particular with regards to the recent debate on the impact of mobile consolidation in the EU. Genakos et. al. (2015) find that both tariff prices and mobile investment increase as result of 4 to 3 mergers. Frontier Economics (2015) concludes that mobile mergers can incentivise investment, but find no impact of moving from 4 to 3 mobile operators on prices. More generally, Houngbonon and Jeanjean (2014) and Friesenbichler (2007) find an inverse U-share relationship between competition and investment. Instead, the study by Lestage et. al. (2011) finds a U-shape relationship between investment and the level of concentration, measured by the Herfindhal-Hirschman Index (HHI). Focusing on the relationship between competition and investment in the mobile industry in China, Kang et al (2012) find a positive correlation between the market concentration and competition measures.

Outside the mobile industry, in the context of fixed broadband networks, there is empirical research looking at the relationship between the type of competition (inter- versus intra-platform) and investment. While evidence is mixed,[123] service based (or within platform) competition seems to deter investment when compared with infrastructure based competition or competition between alternative networks. For example, by examining the variation in facility-based investment in loops across U.S. states and over time, Crandall et al. (2004) find a higher growth of facility-based lines relative to ULL[124] lines in the states with higher costs for ULL. Similarly, Jung et al. (2008), using a panel data model (static and dynamic) with US data, concludes that "it is uncertain that competition spurred by the mandatory sharing policy in this sector stimulates ILECs' incentives to invest in new infrastructure."

On a related matter, there are a number of studies investigating the relationship between liberalisation and investment in the telecommunications sector. Overall, this literature has found a positive relationship between liberalisation and investment.[125] Within this line of research, a number of articles have looked at the interaction between competition and investment. These include Alesina et al.(2005), Li (2008), Wallsten (2001) and Zhang et al.(2008), who find a positive relationship between competition and investment. Recently, Lestage et al. (2013) have found that greater competitive pressure fosters infrastructure investment by state-owned incumbents but reduces investment by private incumbents.

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122 As a measure of innovation they use the average number of patents taken out by firms in an industry, while their main indicator of competition is the Lerner index. They proxy the price cost margin by operating profit net of depreciation, provisions and an estimated financial cost of capital divided by sales.

123 Studies differ in a number of dimensions, including: data set, control variables, statistical approach, etc.

124 Lines based on local loop unbundling.

125 See the literature review included in Lestage et al. (2013).

As discussed below, our key findings are consistent with the existing literature, showing a positive relationship between network competition in mobile sector and key market outcomes, such as coverage, take-up and investment/innovation. Moreover, our analysis works with a unique global data set which provides an insight into the impact of single networks on mobile market outcomes.

## 3.4. Reconciliation of empirics and theory

Regarding the benefits of network competition, the theoretical literature seems to partly support, and partly contradict empirical findings.[126] Both the theoretical and the empirical literature agree that the most densely populated areas will receive coverage first. The straightforward reason for this is that higher population density implies higher profits (in the case of profit-maximizing firms) or social welfare (in the case of a benevolent social planner) given a fixed investment, because more consumers can be reached. Where population density is too low, firms would not be able to recover the fixed costs of roll out and would therefore not provide coverage. This general result holds for both monopolistic markets and markets with some degree of competition. Another theoretical finding that is in line with empirical observations is that as long as there are fixed costs, coverage is inefficiently low compared to the coverage achieved under a benevolent social planner.

The theoretical literature contradicts empirical evidence in that it finds that since a monopolist generates the highest industry profits, a duopoly (or higher degrees of competition) would only be possible in an even smaller set of regions, i.e. that coverage would be lower. The empirical literature discussed in above on the other hand suggests that network competition leads to better consumer outcomes in terms of coverage, innovation and other factors.

This contradiction can potentially be explained by the following: First, the theoretical literature does not account for efficiency gains brought about by firms that are in competition compared to monopolists. It is possible that these efficiencies reduce the fixed costs involved in rolling out into a region. This could explain why coverage under network competition is higher than predicted in theory. Second, operators do not compete on the basis of price alone. Users on a network enjoy positive network externalities the more other users can potentially be reached. Coverage can therefore be a selling point and may induce competing firms to increase coverage beyond the level that a monopolist would provide. Third, the empirical studies discussed in Section 3.3 do not account for supply-side interventions like coverage obligations, which can increase the set of regions with competition. To the extent that such interventions are more prevalent in countries with network competition, this offers an explanation for the observed greater coverage in countries with network competition.

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126 For more detailed discussion on this issue, please see Houpis G., Serdarević G. and J. Veterle (2016): Supply-side measures for policy makers to promote mobile broadband coverage, ITS Regional Conference Cambridge

Therefore, there are plausible practical reasons why one wouldn't expect coverage to be lower under network competition compared with the SWN scenario.

First, under network competition, operators will be trying to get ahead of their rivals. When it is not profitable for multiple operators to rollout in a particular area, it may nonetheless be possible for one network to gain a 'first mover' advantage and capture the entire retail demand in the area. Once they have done so, they can be confident that it would be unprofitable for any other operator to follow, at least until the given area becomes commercially viable for more than one operator.[127]

Second, there are many examples of network sharing across countries. Network sharing can mean that rather than duplicate costs such as towers, infrastructure and equipment, competing networks can share these costs. This makes extensive network roll-out more viable.

Third, coverage obligations imposed at the time of licence award have been used to ensure faster roll out and greater coverage in many countries. The Government provides indirect funding, to the extent that network operators will pay the Government less for a licence which includes obligations to cover areas which are otherwise uneconomic for them to do so.

Fourth, network competition puts pressure on operators to minimise costs. Even though it may be difficult for operators to reduce the unit prices of network equipment, they are able to ensure that they optimise their network and minimise their operating expenditure. Lowering costs should help make it economically viable to roll-out to more areas, which will increase coverage.[128]

Fifth, if unregulated, a network monopoly will have less incentive to extend coverage than network competitors in the same way as a monopoly produces less output than a competitive market.

Advocates of SWNs rarely consider the impact that single networks could have on innovation. Even though mobile technologies are typically developed at an international

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127 This is consistent with the observation that mobile operators in a given country often have different levels of coverage supports, indicating that some areas may only be covered by one operator. At the same time, we recognise that coverage is a dynamic concept and with the decreasing cost of equipment and the increasing demand for mobile services one would expect that more areas become economically viable for multiple networks.

128 It is particularly important to make a like for like comparison when considering the cost of network rollout of the SWN and under network competition, taking into account what spectrum will be deployed on a given mobile network. The cost of rollout will very much depend on the type of spectrum available to the network operator. Low frequency spectrum (e.g. 700 MHz or 800 MHz) requires lower number of mobile masts and base stations (less network equipment), thus making the cost of covering a given area cheaper than if the same area were to covered with higher frequency spectrum (e.g. 1800 MHz of 2.6 GHz spectrum). Therefore, it is misleading to argue that the cost of coverage for the SWN are lower than for other operators under network competition, if this implicitly assumes that the SWN would have exclusive access to low frequency spectrum not available to other operators.

level, the speed at which they become available to consumers depends crucially on *national* policies and market structures. Innovation, broadly defined, drives the speed of adoption of new technologies and technology upgrades in mobile networks. This has a major effect on reducing the unit costs of services for consumers and extending profitable network coverage. One reason why technology upgrades are so important is that each new technology generation delivers significant gains in spectral efficiency. Given that spectrum is scarce, this leads to much needed increases in capacity in mobile networks, Innovation also determines the range of services which consumers can enjoy over the networks that have been built.

In addition, assuming that the SWN would evolve into a network monopoly at the wholesale level in the long term, it will require heavy regulation in the form of access prices to the SWN, coverage obligations, introduction of new services and deployment of new technologies. Given information asymmetries and regulatory failures, regulation is likely to lead to sub-optimal outcomes.

## 3.5. Approach and data used

The key question is how an SWN would perform relative to a counterfactual of network competition. As there are no examples of SWNs in the mobile industry, it is not possible to answer this question directly. However, there are countries that only have a single vertically integrated network. Therefore, to help gain an insight into the potential impact of an SWN, wehave compared the outcomes between countries that have network competition and countries that have single networks. In particular, wehave assessed the impact of network competition on key mobile market outcomes that are likely to drive consumer surplus and welfare from consuming mobile services:

- overall population and geographic coverage (i.e. the availability of mobile services across the country);
- overall take-up (i.e. the realised demand for mobile services); and
- innovation measured as take-up of 'next generation' 3G services.[129]

We have not carried out an analysis of prices, due to the lack of comprehensive data on mobile prices within our sample.[130] Nevertheless, we believe that the impact of network competition on prices is indirectly captured by our take-up variables, as they are closely

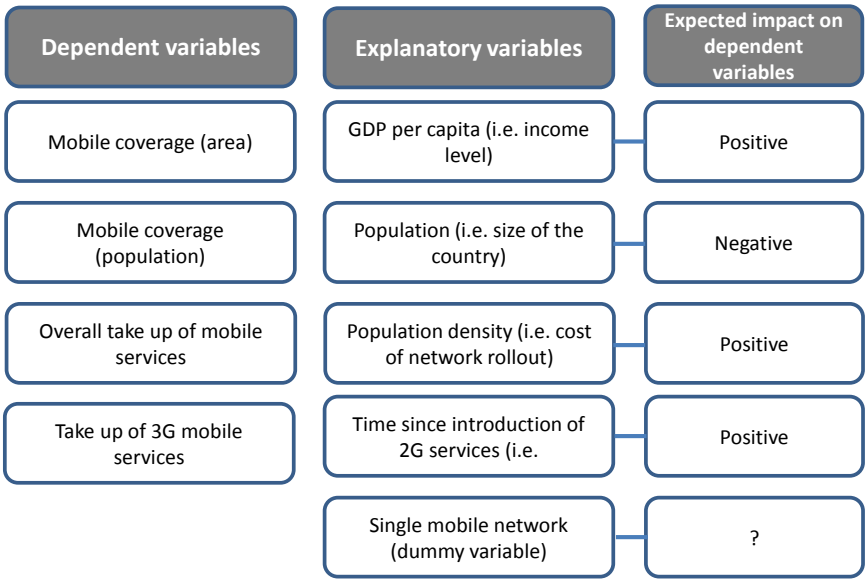
[129] Due to the lack of reliable data on innovation, we consider that the take-up of more advanced mobile technologies (that allow provision of mobile broadband services) can be used as a reasonable proxy for the level of innovation in a given market.

[130] Mobile prices in general are difficult to measure in mobile markets due to the complex nature of tariffs. One option is to use the Average Revenue Per Minute, but the GSMA does not have a comprehensive data set for this variable.

related to the price levels in a given country (i.e. high take-up of mobile services indicates affordable mobile prices, all else equal).

We also controlled for other factors that are likely to influence performance of mobile markets in a given country. This includes, in particular, proxies for mobile demand (such as GDP per capita capturing income levels) and supply (such as population density capturing the cost of network rollout). **Figure 14** provides a conceptual overview of our empirical model and we discuss the variables used in the model in more detail below.

**Figure 14.** Our modelling approach




The data on network coverage comes from the GSMA. The level of coverage is estimated based on the location of base stations in each country, the reach of these base stations and the distribution of inhabitants across the country. This provides estimates of network coverage for the country as a whole, rather than for individual operators. In general, it is difficult to get data on network coverage across a broad range of countries, which is one of the reasons why this paper adds to the existing literature, as we are not aware of any other papers that have analysed the impact of mobile competition on coverage.

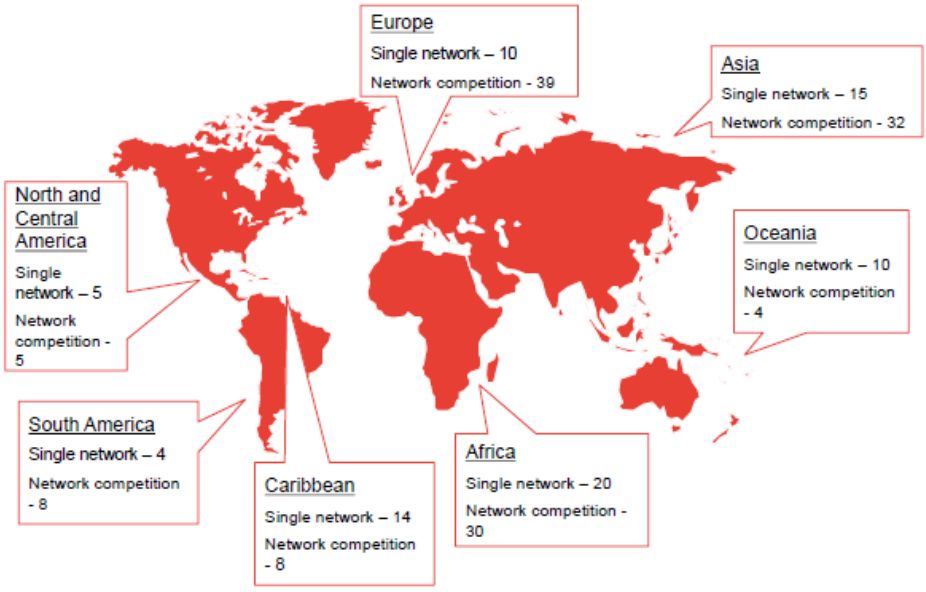
We have also estimated the impact of single networks on overall take-up. SWN proponents claim that SWNs could also reduce costs by avoiding inefficient duplication. It is difficult to assess the direct impact of single networks on costs, due to a lack of data availability on network costs. Nevertheless, costs of building and operating a mobile network will be an important driver of retail prices, with lower network costs likely to be reflected in lower retail prices for consumers. Therefore, as costs are likely to feed through into prices and

thereby influence take-up, we can capture the effect of the SWN on costs by assessing have the impact of single networks on overall mobile take-up[131]

Finally, we have assessed the impact of single networks on innovation by considering the impact on 3G take-up. As 3G represented an upgrade to mobile networks which made mobile internet much more widespread, 3G is a good proxy for the impact that SWN could have on innovation. This is an important point, since innovation plays such a large role in the mobile sector.

For the analysis on coverage and overall take-up, we have used data from 2001. This is because there were significantly more single network countries when using historical data. The year 2001 is the first year in which there is coverage data for a wide range of countries. The other benefit of using data from 2001 is that there was considerable variation in the level of coverage across countries (in contrast, many countries now have close to 100 per cent coverage). The following map shows the number of countries with single networks and network competition across different regions in 2001.

**Figure 15:** Countries with single network and network competition




*Source: Authors' own analysis based on GSMA Intelligence database*

For the analysis on 3G take-up, we have used data from 2012q4, given that 3G is still a relatively new technology in some countries.

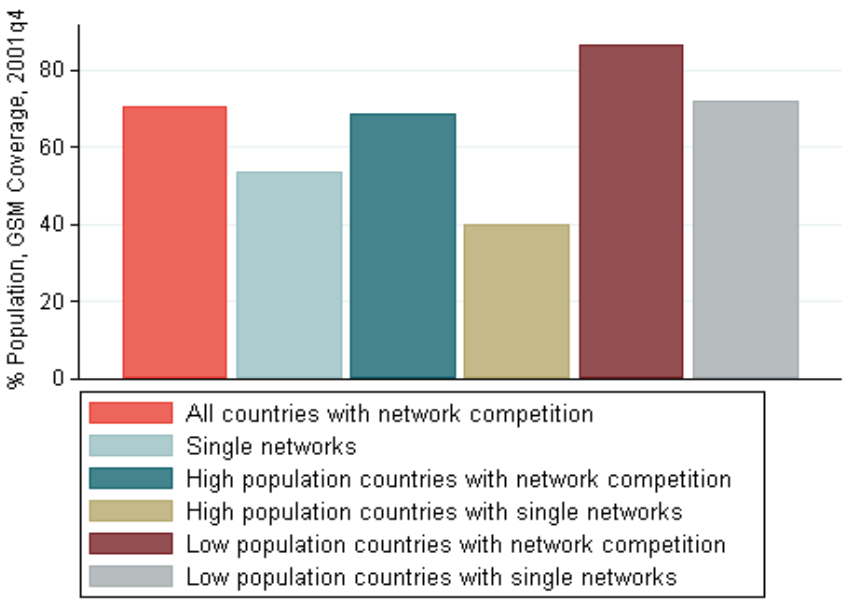
As shown by the following graphs, it appears that outcomes on coverage, overall take-up and 3G take-up are more favourable under network competition. The graphs show that this conclusion still holds when splitting the sample based on the population of countries[132].

131 Mobile take-up is measured based on the number of unique mobile subscribers. This is different to the number of SIM cards since some subscribers have more than one SIM card.

132 Low population countries are defined as countries with fewer than a 1 million inhabitants.

**Figure 16** shows that overall population coverage was considerably higher in countries with network competition (70.4% compared to 53.4% when including all countries regardless of their size)[133]. We have carried out the same analysis for area coverage (see **Figure 17**). Again they find that coverage is much higher in countries with network competition (47.9% compared to 31.4% when including all countries regardless of their size).[134] We have also considered how the take-up of 3G[135] compares across countries (see **Figure 18**). The results also show that 3G take-up is much higher in countries with network competition.

**Figure 16:** Total population coverage in countries with single networks and network competition (population split)



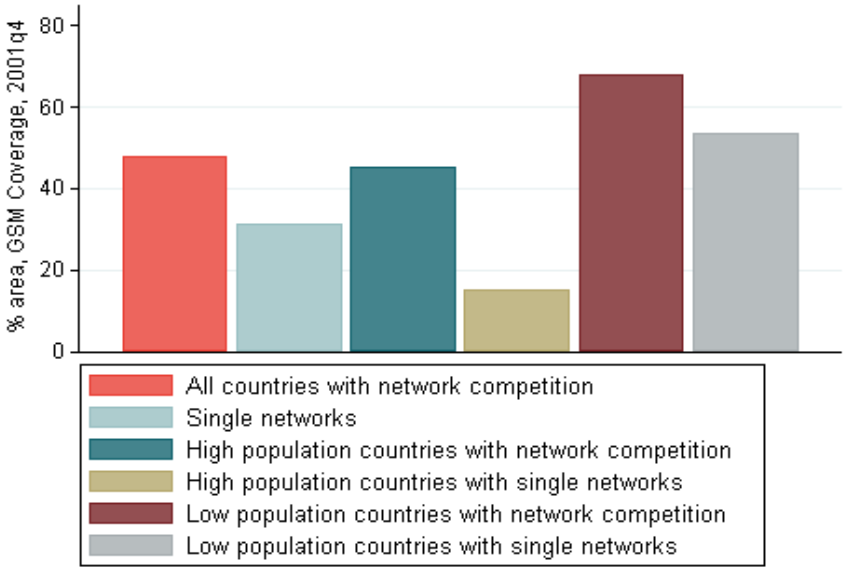

*Source: Analysis based on GSMA data*

133 This difference is statistically significant with a p-value of 0.0029.

134 The difference for all countries is statistically significant with a p-value of 0.0229.

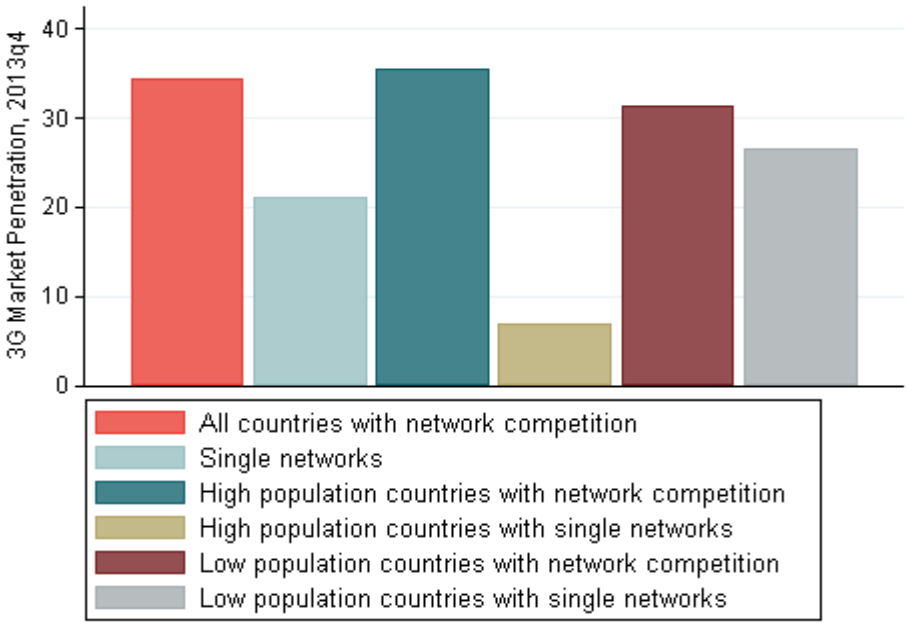
135 3G take-up is measured based on the number of SIM cards. Although this will overstate the number of unique subscribers, we have no reason to believe that this will affect the relativity between take-up in countries with single networks and network competition.

**Figure 17:** Total area coverage in countries with single networks and network competition (population split)




*Source: Analysis based on GSMA data*

**Figure 18:** Take-up of 3G in countries with single networks and network competition[136]




*Source: Analysis using GSMA data*

[136] We have not shown a graph with the countries split by GDP per capita due to a lack of data availability.

To assess whether the graphical analysis of the impact of network competition is accurate, we have performed an econometric analysis. This helps ensure that the differences in outcomes between countries with single networks and network competition are not driven by other factors. All of the regressions are carried out at a single point in time, so do not include a time dimension. This means that they are relying on variation across countries, rather than variation that arise due to countries switching between single networks and network competition.

The impact of single networks has been captured by using a dummy variable, which takes a value of 1 when a country has a single network and 0 otherwise. We have identified which countries have single networks by using the GSMA's database on network deployments. This data set shows when operators launched networks across different countries. In a few select countries, such as Lebanon and Syria, there may be multiple operators that are owned by the government, which means that such operators may compete less intensively with each other than under separate owners. As a sensitivity analysis, we have therefore reclassified these two countries as single networks, which have only a very minimal impact on the results.

We have included different explanatory variables in their regressions to help isolate the impact of single networks. They have included a range of demographic variables, including GDP per capita, population size and population density. As a sensitivity check, they have also included a variable measuring the number of years since 2G was launched in the country. The time at which 2G is launched could impact coverage and take-up as it is a variable that is largely outside of the control of operators because it depends on when regulators or the Government decided to provide the necessary licences and spectrum. There are clearly other variables that could affect the outcome in mobile markets, such as prices, subsidies, coverage obligations and the degree of network sharing. However, it is difficult to collect data for these metrics for such a broad set of countries as we have in our sample. Ultimately, the question is whether any of the omitted variables might also be correlated with whether there is network competition. The answer is probably yes, at least for prices. However, this bias would actually lead us to understate the impact of network competition on coverage. As prices will be higher in single network countries, the estimated parameter in the regression will be higher for countries with single networks. Therefore if anything, we would be overestimating the impact of single networks on coverage and take-up

The following equations show the different specifications:

$$\textit{Overall population coverage} = \alpha + \delta * \textit{single network} + \beta * \textit{GDP per capita} + \gamma * \textit{population} + \eta * \textit{population density} \quad (11)$$

$$\textit{Overall area coverage} = \alpha + \delta * \textit{single network} + \beta * \textit{GDP per capita} + \gamma * \textit{population} + \eta * \textit{population density} + \zeta * \textit{time since 2G} \quad (12)$$

$$\textit{Overall mobile take-up} = \alpha + \delta * \textit{single network} + \beta * \textit{GDP per capita} + \gamma * \textit{population} + \eta * \textit{population density} \quad (13)$$

$$\textit{Overall mobile take-up} = \alpha + \delta * \textit{single network} + \beta * \textit{GDP per capita} + \gamma * \textit{population} + \eta * \textit{population density} + \zeta * \textit{time since 2G} \quad (14)$$

$$3G\ take\text{-}up = \alpha + \delta * single\ network + \beta * GDP\ per\ capita + \gamma * population + \eta * population\ density \quad (15)$$

The following table shows the summary statistics for the variables of interest. All of the data comes from the GSMA database.

**Table 13:** Summary statistics for overall coverage and take-up regressions

| Variable | Mean | Median | Standard deviation | Minimum | Maximum | Quarter |
|---|---|---|---|---|---|---|
| *Overall area coverage* | 44.25% | 32.37% | 0.39 | 0.04% | 100% | Q4 2001 |
| *Overall population coverage* | 66.28% | 71.73% | 0.31 | 0.02% | 100% | Q4 2001 |
| *Overall take-up* | 19.53% | 11.77% | 0.2 | 0.03% | 76.94% | Q4 2001 |
| *GDP per capita (current $)* | 8,208 | 2,191 | 12,689 | 92 | 75,703 | Q4 2001 |
| *Population (million inhabitants)* | 30.2 | 5.2 | 1.21*10^8 | 596 | 1,290 | Q4 2001 |
| *Population density (inhabitants per $m^2$)* | 371 | 73 | 1,757 | 0.14 | 16,183 | Q4 2001 |
| *Time since introduction of 2G (quarters)* | 8,208 | 2,191 | 12,689 | 92 | 75,703 | Q4 2001 |

*Source: Analysis based on GSMA data*

**Table 14:** Summary statistics for 3G take-up regressions

| Variable | Mean | Median | Standard deviation | Minimum | Maximum | Quarter |
|---|---|---|---|---|---|---|
| *3G take-up* | 28.82% | 32.37% | 0.2 | 0.02% | 239% | Q4 2012 |
| *GDP per capita (current $)* | 13,610 | 4,948 | 20,144 | 231 | 115,038 | Q4 2012 |
| *Population (million inhabitants)* | 30.1 | 4.8 | 1.25*10^8 | 596 | 1,380 | Q4 2012 |
| *Population density (inhabitants per $m^2$)* | 400 | 73 | 1,969 | 0.14 | 19,509 | Q4 2012 |

*Source: Analysis based on GSMA data*

We have estimated our regressions using Ordinary Least Squares (OLS) with robust standard errors to correct for heteroskedasticity. In the academic literature, there is a debate as to whether there is a two-way relationship between market structure and market outcomes. For example, it is sometimes argued that market outcomes could impact the number of players in the market as well as vice versa. If there is such a two-way relationship, then it may not be appropriate to use OLS. However, they do not consider this to be the case in this particular situation. When and whether a mobile market moves from one to several

operators is largely determined by when regulators or the Government decide to liberalise the market. This decision will in most cases be independent of market outcomes. Even if the decision was influenced by market outcomes, it is unclear in which direction the relationship would run. On the one hand, regulators or the Government may decide to liberalise markets once they reach a certain size or level of performance. On the other hand, regulators or the Government may decide to liberalise markets if they consider that the market is underperforming.

## 3.6. Econometric results

In this section, we present our econometric results. We show that single networks lead to lower coverage, take-up and innovation, as measured by 3G take-up (see **Figure 14** above for an overview of our model).

The table below shows that single networks have lower population and area coverage once other factors have been controlled for. In particular, the results show that having a single network reduced total population coverage by between 12 and 21 percentage points (depending on whether time since 2G was introduced is controlled for) and reduced area coverage by between 15 and 24 percentage points.

**Table 15:** Regression results for population and area coverage

| | **Overall population coverage** | **Overall population coverage** | **Overall area coverage** | **Overall area coverage** |
|---|---|---|---|---|
| *Single network* | -12.20** | -20.79*** | -14.55*** | -23.58*** |
| *GDP per capita* | 0.000812*** | 0.00117*** | 0.00109*** | 0.00146*** |
| *Population size* | -3.00e-08* | -1.83e-08 | -4.17e-08*** | -2.90e-08** |
| *Population density* | -0.00105 | -0.00102 | 0.000194 | 0.000221 |
| *Time Since 2G was launched* | 1.574*** | | 1.636*** | |
| *Constant* | 29.97*** | 61.28*** | 3.445 | 36.1*** |
| *Observations* | 137 | 137 | 136 | 136 |
| *R-squared* | 0.521 | 0.324 | 0.471 | 0.335 |

*Source: Analysis based on GSMA data*

In the next table we present the results on the impact of single networks on take-up. The results suggest that having network competition increased overall take-up by between 7 to 12 percentage points depending on whether the time since 2G was introduced is included in the model. These results suggest that even if single network countries had launched 2G at the same time as countries with network competition, take-up would still have been lower in single network countries.

The table also shows the results of the impact of single networks on 3G take-up. Again, they have found that single networks have a detrimental impact. The results suggest that having network competition increased 3G take-up by 17 percentage points once other factors have been accounted for. These results suggest that single networks are slower to innovate.

**Table 16:** Regression results for take-up

| | Overall take-up | Overall take-up | 3G take-up |
|---|---|---|---|
| *Single network* | -6.928*** | -12.34*** | -16.91*** |
| *GDP per capita* | 0.00104*** | 0.00118*** | 0.00109*** |
| *Population size* | -1.63e-08*** | -1.19e-08** | -2.13e-09 |
| *Population density* | -0.000991 | -0.000847 | 0.00730*** |
| *Time since 2G was launched* | 0.515*** | | |
| *Constant* | 4.014** | 13.49*** | 11.99*** |
| *Observations* | 175 | 175 | 157 |
| *R-squared* | 0.683 | 0.616 | 0.716 |

*Source: Analysis based on GSMA data*

In addition to the above specifications, we have also conducted a number of sensitivity tests (not shown). In particular, they have used a later time period (2005) for the overall coverage and take-up regressions, have used a measure of political risk based on data from the World Bank and have included urbanisation. None of these sensitivity tests change our overall conclusion that network competition delivers favourable outcomes.

## 3.7. Conclusion

This paper has added to the existing literature by assessing the impact of mobile network competition on a range of outcomes, including network coverage. The key conclusion is that mobile network competition has delivered superior outcomes to single networks. Clearly, the paper does not provide a complete assessment of all of the determinants of consumer outcomes, as it is challenging to accurately capture all differences in regulatory frameworks and market conditions across countries. However, it does highlight the importance of network competition, and provides a platform for future research into how best to leverage network competition to achieve positive consumer outcomes.

The empirical evidence on the evolution of mobile markets suggests that network competition leads to higher coverage. We found that population coverage was up to 21% higher in countries with network competition compared to countries served by a single network, all else equal.

There are several plausible explanations for why coverage isn't higher in single network countries. Due to operators trying to gain a first mover advantage, under network competition, it is still possible that certain areas may only have one operator if it isn't

profitable to have more than one operator. There is also widespread evidence of network sharing and coverage obligations, which both lead to higher coverage. Also, when faced with competition, operators will be under pressure to minimise their costs, which will help make more areas economically viable and extend network coverage. Lastly, it seems that regulatory obligations to extend coverage in these countries, if existed, has not been as effective as network competition. This is not surprising given that regulation is less effective than competition to enhance welfare.

Our results also show that overall take-up is higher in countries with network competition, which as in the case of coverage, indicates that such markets are performing better. Lastly, we found that countries with network competition have greater innovation. For instance, we found that having network competition increased 3G take-up by 17 percentage points compared to having a single network, once other factors have been accounted for.

The findings are consistent with the previous research showing significant benefits of competition on outcomes in mobile markets. At the same time, the research is unique in its focus and the results are based on a sufficiently large dataset to provide a sufficient basis for Governments and policy authorities to consider much more carefully the potentially detrimental impacts of SWNs. At the same time, we recognise that there are further areas in which our research could be expanded and improved. In particular, extending our analysis to panel data will introduce time dimension and allow to better control for country specific effects that might be driving performance of individual mobile markets. In addition, distinguishing between different forms of single network solution, i.e. countries where some form of retail competition might be present or retail prices are subject to regulation (in contrast with 'true' single network monopolies) could provide some additional insight into the expected performance of SWNs.

The results of our analysis have significant policy implications, as they indicate that implementing an SWN could have an adverse impact on consumers. Governments and regulators should consider carefully the benefits of introducing SWNs as a replacement to competition between mobile networks. Moving to a regulated monopoly provision of wholesale network mobile services involves a significant risk of such policy measures slowing down technology innovation. This subsequently affects the associated consumer benefits from the complete removal of the incentive to compete at the network level, which appears to be critical for innovation.

The experience from fixed segment (e.g. NBN in Australia) indicates that setting up an SWN will be challenging, as governments and regulators will need to address a range of issues, such as whether the assets and customers of the existing operators are transferred to the SWN, the governance arrangements of the SWN, and attracting investors for the SWN. Once an SWN has been established, it will need to be regulated on an ongoing basis, given that it will have monopoly power. Setting prices and expected quality levels for a monopolist is never easy, and will be particularly challenging in this scenario, as there will be a lack of historical data. If the SWN does end up failing, then it will not be straight-forward to return to network competition, during which time consumers could suffer considerably.

At the same time, there are several policy options that regulators and governments can rely on if they are concerned about the level of mobile coverage. For example, they can encourage network sharing agreements, they can provide rural subsidies and/or they can set coverage obligations when selling spectrum rights. These alternatives are far less risky than an implementing an SWN and still allows the mobile sector to benefit from network competition. Therefore, we believe that Governments considering some form of intervention in mobile markets should carefully assess pros and cons of different policy measures, taking into account the risks attached to untested solutions such as SWN and the potential long-term consequences on the mobile markets in a given country.

## 3.8. Annex 3

**Table 17:** Countries with single and multiple networks in Q4 2001 and Q4 2012

| | **Single network countries** | **Multiple network countries** |
|---|---|---|
| Q4 2001 | 78 | 127 |
| Q4 2012 | 33 | 205 |

**Table 18:** Correlation between dependent and independent variables in the coverage regressions

| **Variable** | **Overall area coverage** | **Overall population coverage** | **Overall take-up** | **Single network dummy** | **GDP per capita** | **Population** | **Population density** | **Time since 2G** |
|---|---|---|---|---|---|---|---|---|
| *Overall population coverage* | 0.8394 | 1 | | | | | | |
| *Overall take-up* | 0.7657 | 0.7430 | 1 | | | | | |
| *Single network dummy* | -0.2329 | -0.2822 | -0.2239 | 1 | | | | |
| *GDP per capita* | 0.5112 | 0.4856 | 0.7185 | 0.0325 | 1 | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Population* | -0.1104 | -0.0702 | -0.1035 | -0.1292 | -0.0716 | 1 | | |
| *Population density (inhabitants per $m^2$)* | 0.2082 | 0.1478 | 0.1672 | 0.1198 | 0.4517 | -0.0175 | 1 | |
| *Time since introduction of 2G* | 0.5427 | 0.6154 | 0.5514 | -0.2542 | 0.3018 | 0.1265 | 0.1139 | 1 |

**Table 19**: **Correlation between dependent and independent variables in the 3G take-up regression**

| Variable | 3G take-up | Single network dummy | GDP per capita | Population | Population density |
|---|---|---|---|---|---|
| *Single network dummy* | -0.1261 | 1 | | | |
| *GDP per capita (current $)* | 0.7622 | -0.0596 | 1 | | |
| *Population (million inhabitants)* | -0.0563 | -0.0207 | -0.0607 | 1 | |
| *Population density (inhabitants per $m^2$)* | 0.5327 | -0.0236 | 0.2419 | -0.0217 | 1 |

# 4. Appendix: Response to reviewers' reports for the dissertation pre-defence

Below we set out responses to reviewers' reports, indicating where in the final version of the thesis the specific comments were incorporated. Comments that we believe were fully addressed during the pre-defence presentation are not discussed here again.

## 1.1. Chapter 1

Reviewer 1

1. *The introduction chapter should include a clearer and more comprehensive description of what the 2004 reform of the EU merger regulation was actually about, as this is the key element of the empirical analysis presented in the first essay.*

We now include a brief description of the 2004 regulatory reform in the Introduction chapter (pages 3 and 4)

2. *The first chapter (essay) would also benefit from a more detailed discussion of the empirical findings and their potential policy implications. For instance, the finding that Phase II proceedings lead to a higher probability of pro-competitive deal being blocked or (approved with remedies) is highly relevant and could be driven by various factors (e.g. the greater opportunities for third parties to intervene in Phase II may mean remedies become more likely and significant). The author should attempt to interpret these results more carefully and try to go beyond a purely descriptive approach (recognizing the limits any such analysis).*

We now include a high level discussion on the potential implications of our key findings in the conclusion section (pages 35 - 37)

Reviewer 2

3. *The first essay asks very important question – whether the 2004 reform of the European merger control led to higher efficiency. The methodology used in the paper is based on the idea that it is possible to evaluate merger's competitive effects using changes in the market value of competitors. Therefore, only mergers where both merging parties and the main competitors are traded on stock markets are taken into account. Traded are usually just larger firms and therefore the created database will not contain a representative sample of merging firms.*

This is a valid comment. We recognise that our sample is obviously not fully representative for multiple reasons: i) over-representing of phase II cases, excluding cases where no documentation available, iii) excluding cases where merging firms are not publicly listed, iv) excluding cases where competitors not are not publicly listed. Therefore, our analysis relies on 'bigger' and more recent merger cases, but it is not obvious that this is causing an obvious bias in the results of our analysis.

We recognise it could be the case that our sample overemphasizes the potential drivers of different discrepancies, i.e. if the Commission is indeed discriminating against foreign acquirers, this effect is likely to be most visible in the case of large foreign acquirers. If we don't find this relationship to hold in our sample, it is unlikely to hold for a more representative sample. At the same time, we need to be probably more cautious when interpreting positive findings, i.e. if the Commission is now making less type II discrepancies in Phase II, this may hold for larger mergers, but not necessarily for smaller ones (in the more representative sample).

We now acknowledge this issue explicitly in footnote 33.

4. *Since it is controversial whether it is reasonable to look at the stock market responses to evaluate the merger's competitive effects and given the non-representativeness of the sample, I would strongly prefer analyzing the effects of the merger control reform by looking at the real ex-post effects of mergers on competition and prices in the relevant markets, instead of relying on stock market responses.*

This is again a valid comment, but it needs to be acknowledged that the proposed ex-post approach creates other methodological issues as it: i) reduces the sample only to mergers approved by the Commission (with or without remedies), i.e. we cannot evaluate whether a blocked was a 'correct' decision or not; and ii) for the mergers approved with remedies, it does not allow to evaluate whether any pro-competitive market outcomes observed ex-post are a result of remedies or merger being pro-competitive in the first place.

As explained in Chapter 1.3.1., the main advantage of our ex-ante approach is that we have an independent (albeit imperfect) assessment of the merger's competitive effects which we can compare with the Commission's decisions. Moreover, we observe stock market reactions on the day of the announcement irrespective of whether the merger is approved by the Commission in the end. We thus avoid the censoring problem, as we can include in our sample cases where the merger was blocked by the Commission.

## 1.2. Chapter 2

<u>Reviewer 1</u>

5. *The empirical work in the second chapter (essay) focuses on the short-term relationship between different types of market entry (bitstream, ULL and own infrastructure), without properly testing for potential long-term effects. This could be incorporated in the final version of the thesis, if technically feasible.*

We recognise explicitly that visual results presented in Figure 2 may potentially indicate some long-run relationship between lagged bitstream and ULL lines, which is not captured by our current econometric analysis which focuses on short-term effects only (see page 64). We acknowledge that one possible approach to address this would be to test for the existence of long-term relationship between bitstream and ULL within a dynamic model, but

we consider this type of estimation would only make sense once the longer time series is available (and is thus outside the scope of this dissertation).

Reviewer 2

6. *Is it interesting to ask whether either a partial LoI or full LoI approach to entry and expansion explains competitive outcomes in CEE countries? I think the answer is clear for people from telecom industry. I think that more interesting research question would be to determine real causes of the different development of broadband markets in the CEE compared to WE.*

We agree that determining real causes of the different development of broadband markets in the CEE compared to WE is an interesting (and complex) question for further research, but not necessarily the one that the current thesis is focusing on, as our main goal is testing quantitatively whether the evolution of broadband markets in the CEE countries was in line with the LoI theory.

7. *Does it add value to run the two regression equations (eq. 9 and 10)? The regressions use few observations (86 – 120 obs.), 8 years of data (2004-2011, bi-annual data set) for 10 countries. Would not be better to describe the development of the broadband markets in each country as a case study?*

We do recognise that a detailed case study of each CEE country in our sample could be a useful complement to our empirical analysis, but our primary objective is a quantitative assessment of the LoI theory.

We have provided more discussion of the broadband market developments in Slovenia, Slovakia and Croatia, three CEE countries where there have been more significant take up of wholesale access services, to explore to what extent this may be consistent with the ladder of investment theory (see pages 49 to 51). We have also included a cross-reference to Figures 10 and 11 in annex, which show in more detail the evolution of broadband markets in each CEE country individually.

8. *I do not fully agree with the description and view of the author on evolution of broadband markets in WE and CEE countries and on differences between these countries. Specifically: on page 61, the author claims that "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." […] There might be quite different reasons why for alternative operators in CEE countries it was not possible to climb the ladder in the same way how operators in WE countries did. e.g. in the Czech Republic, alternative operators were not able to build gradually a sufficient customer base and brand that would allow them to start with resale and bitstream, then LLU up to development of their own infrastructure. Several reasons might be behind it: a) there might be abuses of dominant position of*

*the owner of the fixed network who might have margin squeezed alternative operators, b) regulatory failure.*

This is a valid comment and we recognise that the quality of regulation (including potential regulatory failures materialising from abuses of dominance) may be another important driver behind the evolution of broadband markets in the CEE region. We recognise this explicitly in Chapter 2.2.3 (pages 54). However, we also note that it is inherently difficult to control for these qualitative / institutional factors within our econometric analysis due to the lack of reliable time series data.

9. *Regulatory failure – it is also possible that national telecommunication regulators in CEE countries did not succeed to create suitable conditions for alternative operators to climb the ladder.*

As per the previous comment.

10. *The author is well aware of the margin squeeze cases (see e.g. p. 61) but he does not account for it (with the exception of excluding Poland and Slovakia from the sample as a robustness check). I am not surprised that no evidence for the ladder of investment theory was found in CEE data if in the sample there are countries like the Czech Republic.*

As per the previous comment.

11. *On page 63, 64 and 65 there are figures that illustrate the evolution of service-based and infrastructure-based broadband lines in WE and CEE countries. As a source is written "Authors' own analysis." So we do not know anything about the source of data. In table 12 on page 65 as the source of the main variables (i.e. number of full ULL and shared ULL lines, number of new lines excluding cable and number of bitstream and resale lines) is given European Commission. Given that this in an empirical paper where quality of data is crucial for validity of results, I consider a simple reference to European Commission as a source of data absolutely insufficient.*

4.1. All the data is now properly sourced in Table 12 and Figures 8 to 12 on pages 67 to 71.

## 1.3. Chapter 3

<u>Reviewer 1</u>

12. *The third chapter (essay) would benefit from a more comprehensive literature overview, with a focus on microeconomic theory describing the dynamics between competition and network coverage in telecommunications (Valletti, Barros and Hoernig (2002), Foros and Kind (2003) or more recently Gotz (2013).*

We have now expanded the literature review section to include both theoretical and empirical studies looking at the relationship between network competition and coverage / take up in telecommunications industries, see pages 77 – 83.

Reviewer 2

13. *The research topic is extremely important. The possible move towards single wholesale networks (SWN) might in my opinion hinder economic growth and decrease consumer welfare for decades. It is not possible to explore the effects of the SWN directly since there are no of them. However, I do not consider to be reasonable to compare the outcomes under network competition relative to single networks, as a proxy for SWNs. […] I would make a suggestion: shared networks may lead to competitive outcomes that might be closer to potential outcomes of proposed SWNs and there is already some history of network sharing. It might be possible and more reasonable to compare market outcomes under infrastructure competition and network sharing to shed more light on effects of SWNs.*

We do recognise that our comparison of network competition countries with single network countries is not perfect, as the appropriate comparator should be a situation with network monopoly and retail competition, rather than monopoly at both network and retail level. We agree with the reviewer that shared networks may lead to competitive outcomes closer to potential outcomes of proposed SWNs, under certain conditions. Nevertheless, there is a sample selection bias that does not allow us to practically incorporate this suggestion in our analysis. This is because the countries with high degree of network competition also tend to be the countries where network sharing where is most advanced and widely used by mobile operators. This is likely to be because: i) countries with extensive network competition tend to have lower revenues per customer and higher investment requirements (due to the competitive pressure), so operators have strong incentives to find ways of reducing their cost base through network sharing; and ii) countries with network competition would likely have effective regulatory / competition framework to facilitate extensive network sharing agreements without harming competition at the retail level.