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Regulation Performance and Investment in Telecommunications in the European Union: a policy evaluation approach

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Abstract

According to the European Regulatory Framework in Telecommunications sector, one of the main tasks required from the NRAs is to promote efficient investment and innovation in the field. The aim of this paper is to estimate the relevance of regulation for the growth of investment across 16 EU Countries. This is done estimating how regulation affects revenues and investment elasticity to incumbents' market power. To do so, we use the panel structure of our data and the timing of the introduction of regulation to carry out two "quasi experiments", where incumbents are ideally splitted in two groups, according to whether they are subject to a specific regulation or not. We consider a sample of 16 EU countries from 1997 to 2011. The results seem to to suggest that New Regulatory Framework has little reduced the impact of market share on firm's revenues and investment in the recent years. Over a longer time span instead, being a regulated country does not imply lower revenues and investment by telecommunication companies. Instead, in regulated countries it is likely that the telecom sector benefits from a better economic and institutional environment, which makes firms more productive for a given level of market power. Finally, in countries with a long-lasting regulatory tradition, an increase in market share represents a more significant increase in firm's market power than in a non-regulated country, so that in regulated countries, elasticity of investment to market share turns to be higher.

JEL Classification Numbers: *C21, L43, L51, O52*

Keywords: *telecommunications, regulated industries, investment, European Union*

Contents

1 – Introduction

Over the past decades, in the European Union (EU) the infrastructure industries such as electricity, gas, water supply and Telecommunications have been liberalised and most of the traditionally publicly owned incumbent monopolies have been privatised. Consequently, the EU developed a sophisticated regulatory framework that aspired to the principle of favouring the entrance of new players in these sectors, and characterized by a strong pro-competition flavour. Accordingly, National Regulatory Authorities (NRAs) have been created in order to ensure a successful evolution towards competitive markets, regulate and supervise the relations between incumbents and new comers, who initially dependent on incumbents' services. Among others, one of the main tasks required from the NRAs is to promote efficient investment and innovation in the field. Regarding the European Telecommunication sector, despite Nicoletti and Scarpetta (2005) have underlined how countries with restricted public ownership in the sector and few barriers to entry have experienced improving productivity, recently the necessity of mobilizing important investments for the creation of new next-generation networks, capable of delivering all the benefits of the digital revolution to European citizens, has cast doubts on the validity of the established framework.

The aim of this study is to measure the impact of regulation on incumbents' revenues and investment. More precisely, we mean to estimate how regulation affects revenues and investment elasticity to incumbents' market power. To do so, we use the panel structure of our data and the timing of the introduction of regulation to carry out two "quasi experiments", where incumbents are ideally splitted in two groups, according to whether they are subject to a specific regulation or not. We consider a sample of 16 EU countries[1] from 1997 to 2011.

The paper is organised as follows. In section two we give a brief overview of regulation and investments, notably by providing stylised facts for the European Union Telecommunications sector and a review of the literature. Section three presents the empirical analysis. Section four provides conclusions.

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[1] Austria, Belgium, Czech Republic, Denmark, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Spain, Sweden, and United Kingdom.

2 – Regulation and Investment

2.1 – Some stylised facts for the Telecommunications Sector in the OECD and the European areas

According to OECD (2013), communication infrastructure and service ecosystems continue to show increasing innovation and competitiveness, not only in the sector itself but also in the broader economy. It is well established, among the OECD countries, the awareness that the new digital technologies help to strengthen and sustain their economies, as well as they represent an opportunity to improve social welfare and to address challenges related to equity. As a consequence, the rolling out of broadband infrastructures, fixed and/or wireless networks, continues across the OECD area, jointly with the digitalisation (e.g. in broadcasting), leading to the expansion of the bandwidth available for all types of communication services. Consequently, compared to other sectors, Telecommunication markets appear to be recovering faster from the global financial crisis and are experiencing new growth with increasing revenues, reaching 4.91% in 2011 and 1.24% in 2010, in contrast with a 3.91% decrease in 2009 (Figure 1; OECD, 2013). The overall turnover of the industry in 2011 (USD 1.363 trillion) was higher than the pre-crisis peak of 2008 (USD 1.343 trillion) (OECD, 2013).

Figure 1 – Trends in public telecommunication revenue, investment and access paths

(1980-2011)

4
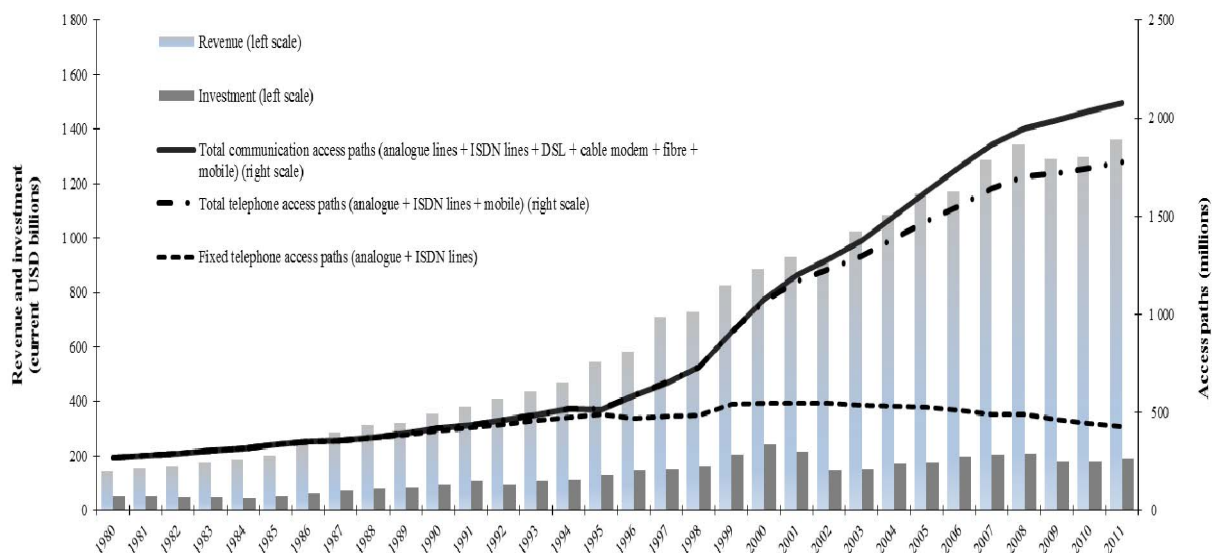
In 2011, after a record growth in the period leading to 2000 and by a subsequent decrease, showing a level at under USD 130 billion from the peak reached in 2000 (USD 240.5 billion)[2], operators invested in telecommunication network just above USD 188 billion, up from USD 180 billion in 2009, still far below the recent 2008 peak (USD 209 billion) (OECD, 2013).

If we look at the nature of the investment and at the context of converging telecommunication services, both within fixed networks (e.g. voice, data and video services) or between fixed and mobile networks (fixed and mobile convergence), many operators are investing in backbone and backhaul fibre networks that can be used both for fixed and mobile communication services to end users. Regardless of the labels applied to fixed networks, such as fibre-to-the-curb, DSL, cable DOCSIS 3 and so on, they all show an increasing deployment of fibre optic cables deeper into those networks, according to the decision to rapidly upgrade part of the infrastructure in relation to competition or the need to reach a certain level of coverage related to a regulatory requirement or commercial target[3]. As of June 2012, the majority of fixed wired broadband connections were provided over DSL (54.8%) and cable modem (30.4%) technologies (OECD, 2013). Fibre's share of direct connections to premises, while still much smaller than DSL or cable, is increasing at a faster pace than the market's overall growth. Between 2009 and 2011, the number of fibre connections increased by 36.2%, from 31.6 million to 43 million (45.7 million in June 2012), in contrast with the 11.1% increase in the number of fixed wired broadband subscriptions (OECD, 2013).

Regarding the public telecommunication investment (i.e. in public telecommunication networks), the largest share in the OECD area corresponds to the Americas region (USD 87 billion), followed by Europe (USD 67 billion) and Asia/Pacific (USD 34 billion). The United States accounted for USD 70 billion of public telecommunication investment, representing over one third (37%) of the global OECD telecommunication investment (Figure 2).

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[2]It coincided with auctions for licences to spectrum allocated for 3G (UMTS, IMT-2000) services for most of the European Countries Few exceptions were Denmark, Greece, Luxbourg, Poland and Sweden. This was equivalent, combined with investment in tangible infrastructure to a correspondent value of USD 327 billion, corresponding to more than three times the total investment in the sector a decade earlier. Following OECD (2005), the main drivers for this raise in investment were construction of second generation wireless networks, the first significant entry into local access markets for fixed networks, and very large commitments by new entrants and incumbents in national and international backbone infrastructure.
[3] The trade-off is whether to bring fibre directly to a premise or to a nearby point and use existing or upgraded DSL and cable infrastructure.

Figure 2 – Public telecommunications investment by region, excluding spectrum fees
(1997-2011)
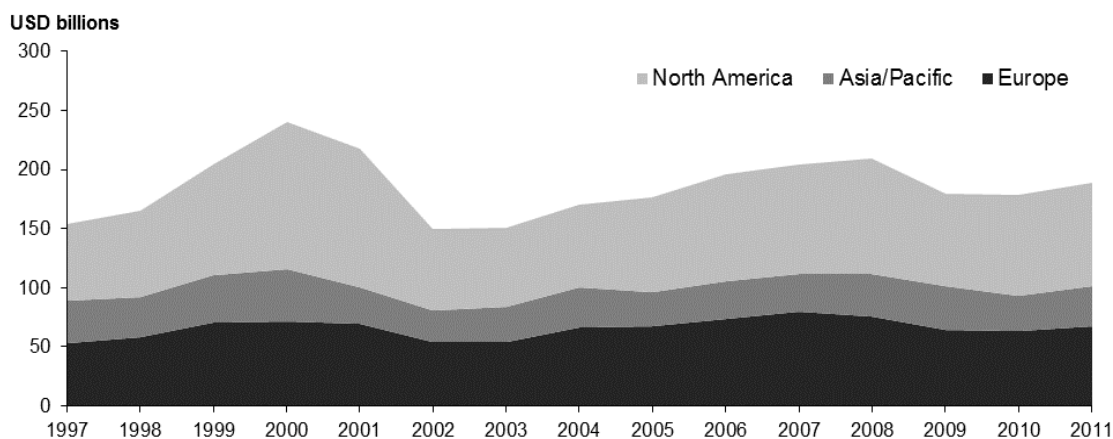
Source: adapted from OECD (2013).

The countries with the highest level of investment, when considering investment as a percentage of telecommunication revenue, were New Zealand (31.7%) in 2010. associated with the introduction of a new mobile operator and the beginning of a publicly funded rollout of a fibre-to-the-home network (see Table 1), Chile (31.1%) and Luxembourg (22.4%). The OECD average remained relatively stable at 14.0% in 2009 and 13.9% in 2011, reflecting a return to higher revenue rather than a decrease in investment. While there have been spikes in investment, such as with the first liberalisation of the market, the trend in recent years has been for these numbers to stabilise at between 14% and 16% of telecommunication revenues.

As expected, those countries with low fixed communication adoption reported high percentages of investment in mobile networks, such as Hungary (63.6%), Turkey (64.5%) or the Slovak Republic (66.6%) and Chile (58.5%). For countries with higher fixed-line penetration, this share remained between 20% and 35%, such as in Denmark (17.7%), Switzerland (18.7%), the United Kingdom (24.2%), Canada (24.5%) and Germany (31.6%)[4] (OECD, 2013).

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[4] Considering investment levels by telecommunication access paths, an indicator of relative investment levels, in 2011, on average, the investment per total communication access path was USD 90.8 in the OECD area, slightly above the investment in 2009. Australia (USD 195.7), Canada (USD 168.0) and Switzerland (USD 161.4) had the highest level in 2011. The countries with lowest investment per access path were Turkey (USD 26.3), Mexico (USD 39.6) and Austria (USD 39.9) (OECD, 2013).

If investment per capita is considered, there are only slight variations in overall investment figures[5]. The highest investment levels per capita were found in Luxembourg (USD 306.2), Switzerland (USD 337.1) and Australia (USD 329.7). Australia, Canada and Switzerland have experienced high increases in their investment levels since 2009, which may be largely due to the appreciation of their national currencies[6]. Significant investment has been made in increasing fibre access in Switzerland and DOCSIS 3.0 in Canada. In Australia, the effects of the NBN (see Table 1) are likely to increase from 2012 onwards (Figure 3).

Figure 3 – Public telecommunications investment per capita

(2009-2011)
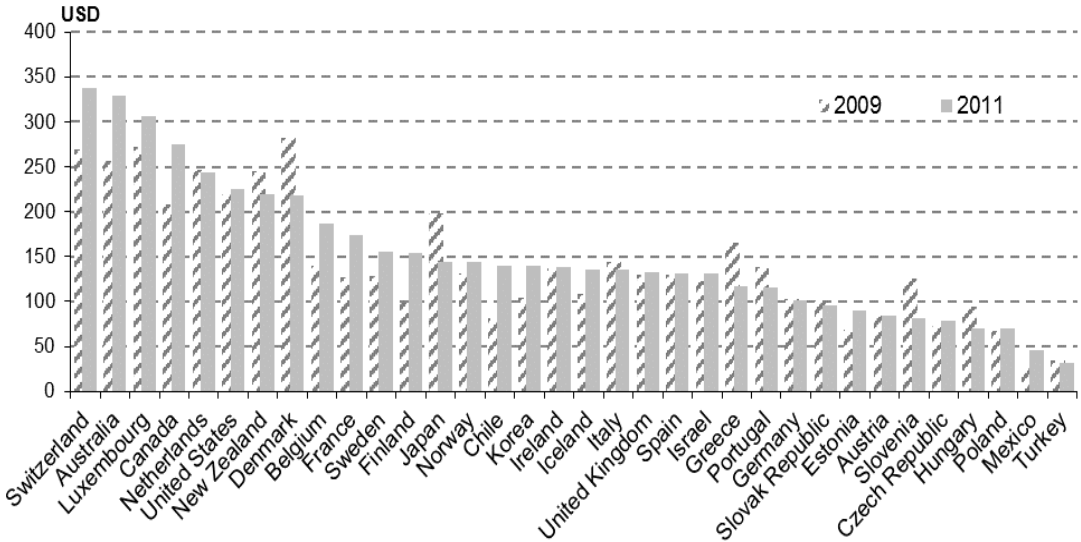
Source: adapted from OECD (2013).

Despite the global positive trends, European investment in telecommunications infrastructure has declined by approximately 2% a year over the last five years, meaning that some €3.5 billion less was invested in 2012 than in 2008[7]. During the same six years, European telcos lost nearly €70 billion in aggregate market capitalization, while so-called *Over-The-Top* (OTT) digital service

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[5] With slight changes in position, the same group of countries led the list using any of the two indicators.
[6] This approach is preferred rather than the use of PPPs, as these figures refer to industry data rather than prices faced by consumers.
[7] In contrast, over the same period, infrastructure investment in comparable international markets has increased by about 2% a year (BCG, 2013).

providers[8], device manufacturers (OEMs), and cable companies gained more than €200 billion. This process was accompanied by a substantial value migration from European to foreign players (BCG, 2013). Moreover, return on capital for the leading telecommunication incumbents in four major markets – France, Germany, Spain, and the UK – averaged 9% from 2007 through 2011, while the average return on capital for leading access seekers (companies that rent infrastructure access from incumbents at regulated wholesale prices) ranged from 13% to 21% over the same period. As a consequence, many European network operators have seen negative returns for their shareholders over the last several years—in stark contrast to their international peers (BCG, 2013).

As mentioned, in Asia and North America fiber access penetration is up to 20 times higher and Downstream speed in mbps 1000 penetration of LTE[9] that is as much as 35 times greater. In a few years, Europe has gone from leader to laggard in advanced digital networks (Parcu and Silvestri, 2014). While consumers in the nations of the EU generally have some of the lowest access costs for both fixed-line and mobile communications services, they also experience slower connections and can have trouble accessing advanced online services[10] (BCG, 2013).

These are long-term trends that show no signs of abating. Revenues of the European telecommunications sector are expected to continue to contract over the next decade, by as much as 2% a year until 2020, representing a cumulative decline of €70 billion to €190 billion. This will further diminish investments in next-generation networks, which means that the EU Digital Agenda targets for broadband coverage and mobile penetration will likely be missed by a wide margin. By 2020, the gap in investment needed to meet these targets will aggregate between €110 billion and €170 billion (BCG, 2013).

In order to provide an explanation for these negative performances, recently, Telecoms regulation in Europe was "accused" of killing the willingness and so the opportunity to invest in the area. It was argued that especially as it applies to advanced next-generation access networks (NGAs), Regulation needs streamlining and restructuring if Europe wants to remain competitive in the global digital marketplace, not to mention meet crucial goals of the EU Digital Agenda (BSG, 2013; Parcu and Silvestri, 2014). In that respect, the European Commission has recently presented a draft recommendation (2013/5761/EC, see Table A4 in the Appendix) on consistent non-

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[8] For a critical review see Scaglioni (2013).

[9] *Long-Term Evolution*, commonly marketed as 4G LTE, is a standard for wireless communication of high-speed data for mobile phones and data terminals. It is based on the GSM/EDGE and UMTS/HSPA network technologies, increasing the capacity and speed using a different radio interface together with core network improvements (LTE Encyclopedia, 2014).

[10] According to Boston Consulting Group (BCG, 2013) in Europe last year, the value consumers receive from the digital economy was substantial – an estimated €3,700 annually per connected consumer in France, €3,000 in Germany, and €2,600 in the UK.

discrimination obligations and costing methodologies, in order to promote competition and enhance the broadband investment environment. The natural question raised by this intervention is if it will be enough and what the impact on competition will be.

2.2 – Literature review

2.2.1 – Different approaches to the regulatory requirements in telecommunications and the European *New Regulatory Framework*

Looking at OECD countries, there are different approaches to the regulatory requirements for new fibre networks, or other upgraded high-speed infrastructures. Historically, many countries have used a combination of tools such as functional separation and unbundling of copper local loops (LLU) to provide more competitive outcomes, where there would otherwise be limited choice for consumers, and continue to do so. Some countries, particularly those investing in new national fibre networks, have adopted structural separation of wholesale and retail business to remove, by structural means, the incentive and ability of integrated operators, generally of monopoly infrastructure, to favour downstream operations over those of competitors that need to use the network. A further group of countries use a combination of tools such as functional separation and unbundling of copper local loops to provide more competitive outcomes, where there would otherwise be limited choice for consumers. The challenge, for these countries, is that the use of unbundling may prove difficult with new fibre networks. Moreover, if technologies such as vectoring are used in copper local loops connected to fibre, unbundling may also be problematic compared to traditional approaches. While infrastructure competition is preferred this may not be possible in all locations or in all markets. In countries that have traditional cable television networks there can also be competitive pressure. Where there is insufficient infrastructure competition to drive new network investment, policy makers face the difficult choice of taking a public approach, or finding ways to increase private investment to meet their policy objective or some middle path. Understandably, all operators say that they will not invest in upgraded fixed broadband networks unless they can fully benefit from returns on these investments. They and investors may have different views, however, about the nature of these returns: whether they resemble long-term and stable utility-like returns or the higher rates associated with greater risk. For their part, most new entrants, including some mobile operators, contend that new fixed network facilities should also be regulated, as copper networks were, in order to avoid abuse of dominant positions.

The US is the largest broadband market in the OECD, where there has been a shift towards deregulation in the past few years. East Asia holds a far-reaching position in the global broadband communications, not only because it constitutes more than one third of international broadband users, but also thanks to its two member countries – South Korea and Japan – which act a significant part in the worldwide broadband development. In both countries government policy intervention heavily influences regulatory activities and is considered as a substantial factor in promoting broadband services, (Table A1 in the Appendix summarizes some of the key experiences in the OECD area).

The regulatory approach chosen in the European Union area was between full deregulation and government interventions. After the liberalization of telecommunications in 15 EU countries in the beginning of the 1990s, the European Commission left the decision of access regulation to the local loop (LLU) to the member states[11].

In 2000 European legislation with respect to LLU was put in place (see Table A2 in the Appendix). It only required the unbundling of the local loop to operators that had been designated by their national regulatory authorities (NRAs) as having significant market power.

Later in 2002 with the approval of the *New Regulatory Framework* (see Table A3 in the Appendix), the EU updated and broadened its regulatory framework, which shares similar ideas with earlier legislation regarding unbundled access. The key issue of this regulatory framework is that markets should be regulated just in case of risk of significant market power (SMP), showed by operators, which could turn into dominant positions or SMP over customers and competitors (Cave and Huigen, 2008). Accordingly, member states have asked their incumbent telecommunications carriers to unbundle the local loop. In doing so, they wanted to support the introduction of more competition and accelerate broadband deployment.

Currently, the European Commission (EC) is trying to set new rules for the NGN (see Table A4 in the Appendix), according to a more flexible approach, thereby ensuring incentives to invest and overall competition altogether, while considering the importance of regulation of the copper network during the transition[12]. Revenues made on copper constitute an opportunity cost of using the NGN, rather than the copper network[13]. Therefore, as mentioned, the recent recommendation on

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[11] Germany firstly begun LLU in 1996, followed by Denmark in 1998, the Netherlands in 1999 and Italy in 2000.

[12] In fact, the copper network constitutes an imperfect substitute for the NGN, involving a replacement-effect for incumbent and alternative operators.

[13] As a consequence, the access conditions to LLU may or may not favor investment in the transition to the NGN (Bourreau et al., 2012a, 2012b; Cave, 2010; Inderst and Peitz, 2012).

non-discrimination and costing methodologies for the regulation of NGN (see Table A4 in the Appendix) aims at providing pricing flexibility of NGN services; ensuring non-discrimination and sufficient competitive constraints; guaranteeing predictable and stable regulated wholesale-copper access prices that are consistent with the principle of cost orientation; and warranting a level playing-field between incumbent and alternative operators through the implementation of effective and proportionate non-discriminating obligations that facilitate downstream competition (European Commission, 2013).

While an exhaustive judgment of the Ladder of Investment (LOI)[14] strategy is still under analysis by theorists[15], there is no doubt that bringing in competition, through access and interconnection regulation on the legacy networks at the national level, has been a European success. The new problem is how to replicate this success with NGN networks, but before this a question arises regarding how to design a regulation that contributes to, or facilitates, the deployment of the NGN networks in member states. Wholesale obligations will result in access seekers incrementally building their own competing infrastructure. Coinvestment plans between different industry operators can constitute a solution, even though they may create new competitive bottlenecks, depending on the co-investment agreement conditions (Cambini and Silvestri, 2012; Cambini and Silvestri, 2013). Antitrust Authorities' inspection of such agreements, as well as regulations on the access conditions to the new network, may become essential tools by which to guarantee open network development in the market, in particular with respect to the access conditions for outsiders to the agreement. Various possible compensation mechanisms for insiders to the agreement, exchange of information, and other related problems are now under theoretical and practical scrutiny (BEREC, 2012; Nitsche and Wiethaus, 2011).

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[14] According to the investment ladder hypothesis (Cave and Vogelsang 2003; Cave 2006a), entrants enabled by low access fees to build up an installed base and learn about demand and cost conditions will subsequently be encouraged by rising access charges, together with technological progress and falling costs, to roll out their own networks and commence facilities-based competition. Sappington (2005) argues, however, that entrants' rent-or-make decision might be largely insensitive to access charges and that entrants might be willing to pay rental charges that are higher than cost to constrain retail competition. Bourreau and Dogan (2005, 2006), show that optimal (from the incumbent's viewpoint) access charges that are rendered prohibitively high when there is no effective threat of facilities-based entry will decrease over time as technological progress renders entry less expensive. Following this strategy would enable an incumbent to forestall facilities-based entry while extracting the maximum rent from entrants.

[15] The entire regulatory framework was soon disputed as the best way to foster broadband deployment and bring about facilities-based competition (Digital Agenda Scoreboard, 2013). Opponents argue that unbundling distorts entrants' make-or-buy decisions, impedes investment incentives and thus proves to be a failure (De Bijl and Peitz, 2005). As a consequence, altough Countries in North Europe perform better than the rest of the area, a wide theoretical and empirical academic debate on the success of the 2002 framework, and in particular on LOI theory has not yet given a definitive answer to whether the theory actually works in the real world as a way to accomplish the fixed targets (Cambini and Jiang, 2009; Bourreau et al., 2010).

2.2.2 – Regulatory Indexes and the analyses of investment incentives

According to the previous paragraph, we can state that while there are several drivers of lower investments, such as the European economic and financial crisis, regulation—the focus of this analysis— is a central one.

Almost ten years ago Nicoletti and Scarpetta (2005) have reviewed the literature on regulation and economic performance, underlining how little attention was paid to the macroeconomic effects of regulations in the product market. The authors have recognized two reasons behind this attitude: 1) the large cross-country variability in policies and the size of reforms introduced for promoting competition and productivity growth are usually used for explaining cross-country differences in economic performance; 2) the effects of product market reforms on productivity and prices at the industry level have not been investigated in their macroeconomic implications.

Alesina *et al*., (2005), have looked at the effects of regulation on investment in the non-manufacturing sector such as transport (airlines, road freight and railways), communication (Telecommunications and postal services) and utilities (electricity and gas) sectors. In this analysis, a simple dynamic panel model of investment and regulation was estimated, controlling for sector/country fixed effects and common or sector-specific year effects[16]. They measure regulation with a time-varying indicator which captures entry barriers and the extent of public ownership, (among other things), finding that countries with restricted public ownership in the sector and few barriers to entry have experienced improving productivity, as compared with countries in which regulation limits competition and public firms are prevalent. As a result, regulatory reforms that substantially lower entry barriers are likely to stimulate investment.

Accordingly, the authors derive that: 1) the reduction of barriers to entry for private firms associated with the elimination of state control on business enterprises more than compensates the reduced importance of potential overinvestment problems (due to managerial incentives); 2) the marginal effect of deregulation on investment is greater when the policy reform is large and when changes occur starting from relatively low levels of regulation.

Their conclusions seem to be consistent with the analysis conducted by ECTA Scorecard Report (2005), in which, according to the authors, a clear positive relationship between investment and effective regulation was found, regardless of the measure of investment used: Investment as percentage of GDP, Investment per capita (€), Investment as percentage of Gross Fixed Capital Formation (GFCF).The regulatory effectiveness is measured on the Scorecard. In order to gauge it,

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[16] See Alesina *et al*. (2005) and Annex in Nicoletti and Scarpetta (2005) for more details.

they have used three different statistical techniques: rank (or Spearman's) correlation, single regression, and multiple regression.

In the rank correlation case, each country is ranked on the Scorecard and on each of the measures of investment. The results of this analysis have shown that across the whole group of countries, only investment per capita has a strong, positive rank correlation with the Scorecard results. In the second set of investigation, they have produced a number of simple regression models (correlations) implying two-variable (bi-variate) regressions with each of the measures of investment and the Scorecard. In this instance, their findings have presented that the relationship is stronger amongst the higher income countries than the group as a whole. However, as with the rank correlation, the coefficient is stronger and most significant for investment per capita amongst the whole group. Finally, they have developed a multivariate regression model using both the Scorecard and GDP per capita as the independent variables and the various measures of investment as dependent variables. The results of these models have emphasised that the strongest relationship again is positioned between the Scorecard and investment as a percentage of GFCF, allowing for GDP per capita. In the Report, it was underlined that this is the only model reflecting a statistically significant relationship for both independent variables. In fact, following their outcome, these models explain 52% of the variation in investment as a percentage of GFCF. As a result, they have concluded that "for countries wishing to continue to attract a high level of investment in Telecommunications, it remains necessary to have strong, pro-competitive regulation to ensure that new entrants are able to compete effectively with SMP operators" (ECTA, 2005: 45).

Li and Xu (2004), studying the impact of regulation on telecommunications investment that aggregates the fixed-line and mobile using segments instrumental variables (IV) techniques, are an exception. As they have found evidence of complementarity between privatization and competition in deepening network penetration and in restraining the rise of service pricing among privatized operators. Studies of broadband penetration (Wallsten 2005, 2006), an important indicator of a telecommunications market's degree of development as it captures both supply- and demand-side factors, report a negative impact of LLU on broadband. Because it examines investments of individual telecom operators, our study enables us to derive policy conclusions and test in more detail a number of predictions. Finally, most of these studies acknowledge the problem of endogeneity with respect to regulation, but few tackle it econometrically.

More recently, Grajek and Röller (2012) provide evidence of an inherent trade-off between access regulation and investment incentives in telecommunications by using a comprehensive data set covering more than 70 fixed-line operators in 20 countries over 10 years. Their model

accommodates different investment incentives for incumbents and entrants, a strategic interaction of entrants' and incumbents' investments, and endogenous regulation. Their findings show that access regulation has a negative effect on both total industry and individual carrier investment. Thus, promoting market entry by means of regulated access undermines incentives to invest in facilities-based competition. Moreover, evidence of a regulatory commitment problem: higher investments by incumbents encourage regulated access provision. Briglauer (2013) employs static and dynamic model specifications and identifies the most important determinants of the adoption of fibre-based broadband services with recent panel data from the European Union member states for the years from 2004 to 2012. The results show that the more effective previous broadband access regulation is, the more negative the impact on adoption, while competitive pressure from mobile networks affects adoption in a non-linear manner. It appears that the approach of strict cost-based access regulation embedded in the EU regulatory framework is at odds with the targets outlined in the European Commission's "Digital Agenda". Finally, He also finds evidence for substantial network effects underlying the adoption process[17].

As it emerges from the previous *excursus*, all these analyses aim at ashowing what influence regulation has on market results (e.g., on investment activities in the telecommunications sector). They attempt to find a statistical link between Regulatory Indexes (rating figures) and market outcomes by using regression analyses. Regulation Indexes (ratings) are, therefore, considered a careful and methodically correct implementation for these approaches. In fact, as we have seen, despite a standard EU regulatory framework, telecommunications markets are still regulated differently in each individual member state. As a result, many institutions conduct country comparisons in an attempt to illustrate country-specific regulations with numbers.

As mentioned, all the former works have included in their regressions an Index. Specifically, they have considered the ECTA Regulatory Scorecard (ECTA, *VY*), the OECD Regulatory Index (Conway and Nicoletti, 2006) and the Polynomics Regulation Index (Plaut Economics, 2007;

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[17] Robust empirical evidence is difficult to obtain due to a lack of data at micro-level (local exchange level), so aggregate data on investment (Grajek and Roller, 2012) or proxies (Waverman *et al.,* 2007) has been used. A recent study using micro-data found the interesting result that the LOI hypothesis works in the case of entrants who climb the ladder from bitstream access to LLU, but not from LLU to building their own fiber networks (Bacache *et al.*, 2014). Furthermore Bouckaert *et al.* (2010) found that inter-platform competition is the only main driver to spur investment in broadband networks. In a recent paper, Nardotto *et al.* (2012) empirically showed that there are no strong positive effects of LLU entry on broadband penetration levels, which could suggest that the positive competitive effects of this access method are outweighed by the adverse effects of reduced incentives to invest. However, it turns out that, while LLU entry has not raised total broadband penetration across different local markets, it has substantially increased the quality of the service as measured by average broadband speed (Nardotto *et al.*, 2012).

2012)[18]. The first three studies all have in common that they do not attempt to measure regulation but rather rate it with regard to specific questions, while the last aims at providing detailed, comprehensive information on different regulatory measures in the telecom sector for all 27 EU countries during 1997–2011[19].

In the following pages, in order to measure the impact of regulation on incumbents' revenues and investment, we are going to exploit these differences in the regulatory framework. Using ECTA data, Afonso and Scaglioni (2006) construct a so-called Composite Regulatory Performance Indicator (CRPI) to assess the performance of National Regulatory Authorities (NRAs) in telecommunications sector, across the same 16 EU countries considered in our paper. According to this indicator, the regulatory framework in Czech Republic, Hungary and Poland is significantly less effective than in the other countries in the sample (Figure 4). Moreover, this difference persists even after 2004, when these countries joined the EU and implemented 2002 framework.

Figure 4 – Composite Regulatory Performance Indicator (2004-2009):

2004 Acession Countries vs the Others.
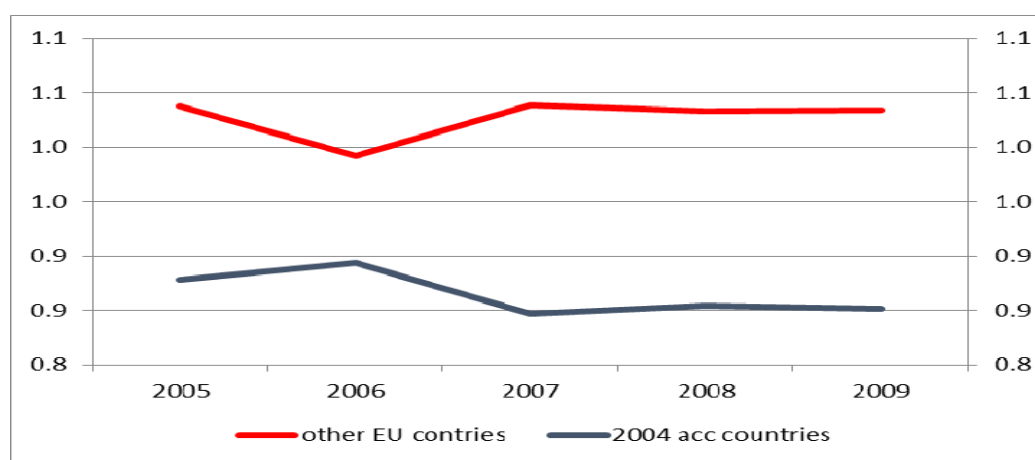
Source: adapted from Afonso and Scaglioni (2006).
Note: The CRPI is a relative index, taking value 1 on average across the 16 countries in each year. The indicator for each group of countries is a simple average of country CRPIs.

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[18] Additionally, the European Union Regulatory Institutions Database (EURI, 2004) and the WIK Indices (Elixmann *et al.*, 2001; WIK, 2003) must be considered. In 2014, ECTA and TUDelft issued a new publication with a Regulatory Institutional Index (RII), which somehow is an implementation of the Regulatory Scorecard (ECTA and TUDelft, 2014).
[19] For a critical discussion on the different Indexes see Afonso and Scaglioni (2006) and Plaut Economics (2007).

3 – Empirical Analysis

3.1 – The empirical specification

As anticipated, in this section, we measure the impact of regulation on incumbents' revenues and investment. More precisely, we mean to estimate how regulation affects revenues and investment elasticity to incumbents' market power. To do so, we use the panel structure of our data and the timing of the introduction of regulation to carry out two "quasi experiments", where incumbents are ideally splitted in two groups, according to whether they are subject to a specific regulation or not. We consider a sample of 16 EU countries[20] from 1997 to 2011.

We first consider the '*New Regulatory Framework*', introduced in 2002. Has the novelty of this framework changed incumbents' reaction to market conditions? In this first experiment all countries are taken into account before and after that date.

In the second experiment instead we look at regulation in a more general sense and we split the contries in two groups: those which have been long subject to a regulatory framework and the others. In this second experiment, we assume that Czech Republic, Hungary and Poland have never been subject to any of *European Regulatory Frameworks* whitin the whole time span considered. Although we are aware that this assumption might not hold in the latest years, we exploit the fact that their accession was relatively recent (2004) and that implementation and coming into force of these regulatory frameworks took time. This hypothesis is confirmed by the flat dynamics of the regulatory index introduced in the previous paragraph (Figure 4).

We then model 4 equations, one equation for revenues and another for investment for the first experiment; other two for the second one:

$$\Delta \operatorname{Re} v_{it} = \beta_0 + \beta_1(Mkt\_Share * \Pr e) + \beta_2(Mkt\_Share * Post) + \sum_k \Delta X_{kit} + \varepsilon_{it} \qquad (1)$$

$$\Delta Inv / \operatorname{Re} v_{it} = \beta_0 + \beta_1(Mkt\_Share * \Pr e) + \beta_2(Mkt\_Share * Post) + \sum_k \Delta X_{kit} + \varepsilon_{it} \quad (2)$$

$$\Delta \operatorname{Re} v_{it} = \beta_0 + \beta_1(Mkt\_Share * No\_\operatorname{Re} g) + \beta_2(Mkt\_Share * \operatorname{Re} g) + \sum_k \Delta X_{kit} + \varepsilon_{it} \quad (3)$$

$$\Delta Inv / \operatorname{Re} v_{it} = \beta_0 + \beta_1(Mkt\_Share * No\_\operatorname{Re} g) + \beta_2(Mkt\_Share * \operatorname{Re} g) + \sum_k \Delta X_{kit} + \varepsilon_{it} (4)$$

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[20] Austria, Belgium, Czech Republic, Denmark, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Spain, Sweden, and United Kingdom.

In the first two equations, we interact our measure of market share with a dummy taking the value of 1 after 2004 (Post), 0 before (Pre). X includes all the other (k) explanatory variables. Although the New Regulatory Framework was sign in 2002, we are taking into account a transition period needed for the regulation to be approved and come into force in each country.

In equation (3) and (4), market share variable interacts with country dummy instead; this dummy is equal to one for Czech Republic, Hungary and Poland (No_Reg); 0 otherwise (Reg).

In equation (1) and (2) we estimate growth rates of revenues, in equation (3) and (4) nominal investment are scaled by nominal revenues[21]. In all the equations Mkt_share represents the market share of the incumbent / entrants, as a proxy of its market power.

As other empirical models on on infrastructure investments, we take take a a reduced-form approach, in which revenues and investments depend on a set of supply and demand characteristics (e.g. Chang et al., 2003; Crandall *et al.*, 2004).

Although we consider a panel of countries, we find that the fixed effect, which represents the unobserved (by country) heterogeneity, is never significant. Hence, we may estimate a simple OLS regression where all coefficients are homogeneous across countries. However, the presence of a significant negative correlation between the fixed effects and the regressors would imply a downward bias of coefficients, if the country effects wouldn't be included. As a results, both the estimates are shown.

To cope with endogeneity issues, which often arise in this kind of model (e.g. Alesina *et al.* 2005), along with OLS/ fixed effect estimates, we carry out IV/GMM estimates. As instruments we used lagged regressors (up to 4); we use the standard 2SLS procedure for the OLS model and Arellano-Bond (1991) GMM estimator for the panel specification.

3.2 – Data

Based on the literature reviewed in section 2.2, we identify four groups of variables that are likely to affect the revenues and investment of a firm: i) demand variables, ii) cost variables, iii) market conditions. The first group consists of variables affecting consumer demand for telecommunications and telecommunications infrastructure. These variables include consumer demand of telecommnication services or consumer wealth / income. The second group covers investment cost variables. Because the density of households determines to a large extent the costs

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[21] Growth rates and ratios are needed to get rid of high persistence / non-stationarity of revenues and investment in a relatively long time span. The use of dynamic panels (e.g. Alesina et al. 2005) would be incorrect in this case.

of building the local loops, a natural cost measure is the population density and the level of urbanisation. The costs of labour and capital obviously play an important role as well. The third group of variables comprises measures of market power. Table 1 describes variables used in each group and their source.

Table 1 – Variables used in the empirical models

VARIABLE	DESCRIPTION	SOURCE
DEPENDENT VARIABLES		
REV	Telecommunication revenue in the OECD area, USD millions	OECD
INVREV	Public telecommunication investment as a percentage of telecommunication revenue	OECD
DEMAND VARIABLES		
GDPS	Gross domestic product USD millions	OECD
ACCESS	Total communication access paths in the OECD area (thousands)	OECD
COMEXP	Communication expenditures as a share of disposable income in OECD countries	OECD
FAMBB	Households with broadband access (% households)	OECD
Interus	Individuals regularly using the Internet (%)	Eurostat
COST VARIABLES		
ULC	Unit labour cost	OECD
RAT	Long-term bond yield	EIU
LRAT	Lending interest rate	EIU
taxrate	Implicit tax rates by economic function	Eurostat
buper	Building permits - annual data (2010 = 100)	Eurostat
MARKET CONDITIONS		
mktsh	Entrants' market share	Eurostat
mktshce	Incumbents' market share in the national telephony market (Minutes of traffic)	European Commission

3.3 – Main results

In Table 2 the results about equation (1) are shown. The dependent variable is the growth rate of revenues; for each column, there is a different estmation technique of the same specification: OLS, IV, Panel with Fixed effect (FE) and GMM-Arellano-Bond (GMM-AB) method respectively. We tried as explanatory variables all those listed in Table 2; as regards equation (1), in addition to market share (logs of percentage points) only growth rate of GDP (dlgdp) and the growth rate of

access paths (dlaccess) turned out to be steadily significant. However, despite of few regressors, the goodness of fit is high in all the esimates.

Due to the negative correlation between the fixed effect and the regressors (-0.329), market share elasticity is biased downward in the OLS estimates, while it is higher in panel equations, when the fixed effect is included. Finally, although some endogeneity bias cannot be excluded, OLS and FE estimates are quite similar to their IV and GMM version respectively.

Table 2 – Regressions. Effect of New Regulatory Framework;

dep. variable: Revenues

Dep. Var.: Dlog(REV)	OLS	IV	FE	GMM-AB	Dep. Var.: Dlog(REV)	OLS	IV	FE	GMM-AB
mkt_sh_ pre	.104**	.073**	.182***	.273**	mkt_sh_ pre	.091**	.061*	.172***	.23***
mkt_sh_ post	.09**	.058*	.173***	.27**	mkt_sh_ post	.077*	0.048	.164***	.227***
dlGDP	.595***	.692***	.672***	.771***	dlGDP	.598***	.686***	.636***	.696***
					dlACCESS	.127**	.172**	0.114	0.227
const	-.396**	-.267*	-.739***		const	-.349**	-.236*	-.707***	
No obs	214	186	214	198	No obs	212	184	212	196
R2	0.4	0.472	0.422		R2	0.507	0.498	0.529	
F-test (FE=0)			0.955		F-test (FE=0)			0.931	
Corr (FE, X)			-0.329		Corr (FE, X)			-0.333	
F-test (pre=post)	22,7	21,1	5,7	0.7	F-test (pre=post)	25,3	23,7	6,9	0.9

As regards our research question about ther impact of the *New Regulatory Framework* on firms' behaviour, equation (1) tells us that revenues elasticity to market share used to be higher until 2004 than it has been in the latest years. Although the magnitude of coefficients looks alike, it is worth noticing that they are highly significant so that their difference is statistically significant, even if seemingly small. The standard F-test for mkt_sh_post= mkt_sh_pre is reject in all cases, but in the GMM-AB estimation.

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Overall, our first equation seems to suggest that the *New Regulatory Framework* introduced in 2002, little reduced the impact of market share on firm's revenues. This result is consistent with a mechanism according to which a more intense/effective regulation (price cap, limits to market power, a more competive market in term of potential entrants) reduces the effect of market power on firm's revenues and profits.

Equation (2) aims to explore if this result holds for investment as well (Table 3). These equations are very simple too, because only growth rate of GDP and consumer expenditure in telecommunication turned to be significant in accounting for investment (on revenues) variation. As expected, market power and demand factors increase the share of investment (on revenues), even if this time equations are less robust (with a lower goodness of fit). Interestingly, comparing Table 3 and 4, elasticity of investment (share) to market share proves to be generally similar to that of revenues. It implies that revenues and investment change together when market condition changes. Finally, the result of a higher elasticity of investment to market power before the introduction of the New Regulatory Framework no longer holds for investiment equations. In fact, it holds only for the OLS / IV estimates, but it doesn't when country heterogeneity is taken into account in the panel specification, which is the correct specification, as this time fixed effects are statistically siginifcant (F-test 4.38***). In this latter case, the difference in elasticity after 2004 is statistically not different from zero, even if still higher than it has been before 2004 in the FE estimation. The fact that country specific factors wipe out the impact of the New Regulatory Framework means that other omitted factors are at work, which affect investment decisions more than the Framework itself. Since all the other explanatory variables (drawn fron Table 2) failed to explain investments, while these time-invariant factors turned to be relevant, it is likey that the share of investments is more dependent on some long-term determinants (institutional framework, rule of law, structure of the economy).

Table 3 – Regressions. Effect of *New Regulatory Framework*;

dep. variable: Investment on Revenues

Dep. Var.: Dlog(REV)	OLS	IV	FE	GMM-AB	Dep. Var.: Dlog(REV)	OLS	IV	FE	GMM-AB
mkt_sh_pre	0.136**	0.021	.318***	0.497**	mkt_sh_pre	0.064	0.031	0.194***	0.35*
mkt_sh_post	0.053	-0.052	0.291***	0.509*	mkt_sh_post	-0.0055	-0.037	0.156*	0.357*
dlGDP	18.4	25.1	14	-4.21	dlCOMEXP	19.9*	15	19.9**	19.6
const	10.6**	17.1***	-4.13		Const	15.1***	16.9***	4.75	15.1***
No obs	214	186	214	198	No obs	195	167	195	179
R2	0.206	0.166	0.292		R2	0.248	0.172	0.356	
F-test (FE=0)			4.38		F-test (FE=0)			4.5	
Corr(FE, X)			-0.297		Corr(FE, X)			-0.261	
F-test (pre=post)	14.3	12.7	1.2	0.2	F-test (pre=post)	13.6	12.0	3.4	0.1

So far, we have focused on the impact of a specific regulatory framework; in this second part of the section, we are going to explore the effects of a generally regulated environment on firms' revenues and investment. As said, to do so, we assume, as simplifying assumption, that three countries (Czech Republic, Hungary and Poland) have never been subject to any of *European Regulatory Frameworks* in the period considered. The empirical exercise is the same as that one carried out above, but this time, sample is splitted in two: regulated and not regulated countries. Again, to keep the experiment feasible, we restrict our analys to the impact of regulation on revenues and investment elasticity to market share.

In Table 4, three different specifications for equation (3), revenues, are shown. Coefficients are generally significant and with the expected sign: revenues depend positively on demand factors (gdp and consumer expenditure) and negatively on interest rates. Market share is always strongly significant in all the specifications.

Table 4 – Regressions. Effect of overall regulation over the whole period;

dep. variable: Revenues

Dep. Var.: Dlog(REV)	OLS	IV	FE	GMM-AB	Dep. Var.: Dlog(REV)	OLS	IV	FE	GMM-AB
mkt_sh_ no_reg	0.186***	0.164***	0.317*	0.22**	mkt_sh_ no_reg	0.172***	0.153***	0.297*	0.249***
mkt_sh_reg	0.197***	0.177***	0.256***	.295***	mkt_sh_reg	0.183***	0.167***	0.245***	0.29***
dlGDP	0.778***	0.895***	0.72***	.827***	dlGDP	0.82***	0.953***	0.752***	0.828***
					dlRAT	-0.053	-0.056	-0.032	-0.052
const	-0.822***	-.743***	-1.12***		const	-.766***	-.702***	-1.07***	
No obs	214	186	214	198	No obs	214	184	214	198
R2	0.365	0.436	0.406		R2	0.37	0.446	0.408	
F-test (FE=0)			1.36		F-test (FE=0)			1.28	
Corr(FE, X)			-0.888		Corr(FE, X)			-0.261	
F-test (pre=post)	10.0	8.4	0.2	0.9	F-test (pre=post)	10.0	8.4	0.2	0.4

Dep. Var.: Dlog(REV)	OLS	IV	FE	GMM-AB
mkt_sh_no_reg	0.163***	0.134***	0.302**	0.252***
mkt_sh_reg	0.172***	0.145***	0.239***	0.299***
dlGDP	0.76***	0.849***	0.679***	0.733***
dlACCESS	0.146**	0.184**	0.121*	0.119
Const	-0.727***	-0.62***	-1.05***	
No obs	212	184	212	196
R2	0.469	0.471	0.513	
F-test (FE=0)			1.5	
Corr (FE, X)			-0.878	
F-test (pre=post)	8.8	7.2	0.3	0.4

As in Table 2, FE are not significant (F-test: 1.36) and strongly negative correlated with regressors (-0.88).

As regards the impact of regulation on revenues, estimates tell us that elasticity to the market share is higher in regulated countries than in the others. This result is confirmed in all the specification with reference to OLS/IV estimates. Yet, when we include FE, this difference turns out to be not different from zero both in the FE regression and when endogeneity is taken into account (GMM-AB).

Equations about investment elasticity (equation (4), Table 5) provide us with similar results. As in Table 3, fixed effects are now significant and country heterogeneity helps explain differences in investment/revenue ratio along with some demand variables (GDP, consumer expenditure) and market share. In all cases elasticity to market share is higher in regulated countries and this difference is generally significant, even in the GMM-AB estimation.

How can we reconcile these findings with the previous ones? Here, unlike the previous estimates, we find that regulation does not negative affect elasticity of revenues and investment to market share, rather the opposite. However, with reference to revenues, this difference disappear when country heterogeneity is taken into account (FE and GMM-AB estimates). That could mean that higher elasticity of revenues in regulated countries is due to some country characteristics, such as higher productivity or efficiency of firms in general, also linked to a better institutional and economic environment, which are missing in the OLS / IV estimates[22]. It is important to recall that in equation (1) and (2), being the sample of countries the same before and after the introduction of the regulation, we are controlling for country-specific characteristics.

The higher elasticity of investment to market share is instead robust to country-specific effects, which are even significant in this case. This result might be due to the higher level of (potential) competition in the regulated countries, given the market share, with respect to the others. In this condition, an increase in market share in regulated countries is more relevant and affect more investment activity, because it is a better indicator of a better (future) economic performance by the firm.

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[22] We tried to include labour productivity among regressors, which nevertheless turned to be not significant. This might means that other unobserved factors are at work.

Table 5 – Regressions. Effect of overall regulation over the whole period;

dep. variable: Investment on Revenues

Dep. Var.: Dlog(INV/REV)	OLS	IV	FE	GMM-AB	Dep. Var.: Dlog(INV/REV)	OLS	IV	FE	GMM-AB
mkt_sh_no_reg	0.173***	0.071	0.123	0.174	mkt_sh_no_reg	0.113**	0.074	0.148	0.113
mkt_sh_reg	0.243***	0.114***	0.376***	0.48**	mkt_sh_reg	0.134***	0.084	0.26***	0.378***
dlGDP	38.2*	38*	21.4	5.92	dlCOMEXP	29***	29.1**	23.6**	13.5
const	0.135	7.98**	-6.49		const	-0.785**	10.7***	0.169	
No obs	214	186	214	198	No obs	195	167	195	179
R2	0.19	0.102	0.295		R2	0.2	0.11	0.346	
F-test (FE=0)			4.8		F-test (FE=0)			5.27	
Corr(FE, X)			-0.657		Corr(FE, X)			-0.481	
F-test (pre=post)	9.9	8.3	2.1	4.7	F-test (pre=post)	1.4	-0.2	0.7	3.2

4 – Conclusion

In this paper, we evaluate the relationship between regulation and economic performance and investment of telecom firms across 16 EU countries. For this purpose we estimate a revenue and an investment equation over the period 1997-2011. We measure the impact of regulation on incumbents' revenues and investment in terms of elasticity to incumbents' market power of revenues and investment. To do so, we use the panel structure of our data and the timing of the introduction of regulation to carry out two "quasi experiments", where incumbents are ideally splitted in two groups, according to whether they are subject to a specific regulation or not.

We first consider the ''*New Regulatory Framework*'', introduced in 2002 and we look at the change in elasticity of investment and revenues before and after that date. In the second experiment instead we consider regulation in a more general sense and we split the contries between regulated and not regulated (Czech Republic, Hungary and Poland).

Our results seem to suggest that New Regulatory Framework has little reduced the impact of market share on firm's revenues and investment in the recent years. Over a longer time span instead, being a regulated country does not imply lower revenues and investment by telecommunication companies. Instead, in regulated countries it is likely that the telecom sector benefits from a better economic and institutional environment, which makes firms more productive for a given level of market power. Finally, in countries with a long-lasting regulatory tradition, an increase in market share represents a more significant increase in firm's market power than in a non-regulated country, so that in regulated countries, elasticity of investment to market share turns to be high.

Appendix

Table A1 – Fiber Development and regulatory Approaches within the OECD area

Country	**Fiber Infrastructures Deployment**	**Regulatory Approach**
USA	LLU triggers extensive debate all over the world, especially in the US. As a result it has landed in intense academic disputation and repetitive in-court challenges ever since. It is criticized that ILECs' incentives to upgrade their networks, to extend broadband deployment and to provide enhanced services were dampened and it did not provide competitive local exchange carriers (CLECs) with enough incentives to move from leasing lines to building their own networks as it had planned to. A notable feature of the US broadband market is strong platform competition between cable television systems and telephone systems. Since the 1996 Act the US reform did not impose any specific regulatory requirements on cable providers that offer Internet services, but on the other hand set relatively strict rules for telephone companies. This created a distinctly asymmetric regulation setting with respect to those two types of companies until the unbundling obligations on the former Bell companies were lifted. Thus, such deregulation process has led US telecom services to a very different chapter.	At first, the 1996 Telecommunications Act sets a number of restrictions on incumbent local exchange carriers (ILECs) and particularly requires them to unbundle their networks and to make the unbundled network elements (UNEs) available to competitors at regulated wholesale rates based on total-element long-run incremental cost (TELRIC).The Federal Communications Commission (FCC) believed that the local loop unbundling (LLU) regime was appropriate to spur competition especially in the early stages when entrants have not yet rolled out alternative infrastructures. Consequently, in response to multiple defeats of earlier rules, the US Court of Appeals sent the entire unbundling and line-sharing regime back to the FCC for reconsideration and the FCC finally in 2005 affirmed the elimination of the unbundling obligation in broadband market.
JAPAN	One of the few OECD countries where fiber networks have been widely deployed. It is also noteworthy that fiber unbundling has been in place since 2001, and investment in fiber access has taken place since the late 90s. Japan introduced local loop unbundling based on long-run incremental cost (LRIC) as early as 2000. Right after the split of its incumbent telecoms carrier Nippon Telegraph and Telephone (NTT) into NTT East and NTT West. This is the response of the Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT) to former NTT's resistance to cannibalize its own business and to open access. In 2003, the government expanded its ''e-Japan'' strategy to stimulate broadband with programs providing a combination of subsidies, tax incentives and low or zero-interest loans for broadband operators. Then further government policies called ''U-Japan strategy'' and ''IT New Reform Strategy'' came out successively in 2004 and in 2006 to further speed up the broadband expansion and network enhancement.	Japan's authorities have expressed concerns about the excessive market power of the incumbent for fiber-based services, as its market share is far higher for fiber than for DSL services. This has raised the question of whether change in the regulated access conditions, to these networks, should be undertaken.
KOREA	By far the largest proportion of fiber connections in the world. The rapid development of broadband services in South Korea is largely related to government backing up including investment, subsidies and so on, especially after the 1997 economic crisis when the Korean government targeted broadband Internet as a new opportunity for economic growth. The most acclaimed example is the KII-initiative launched by the government which offered loans to operators investing in high-speed infrastructures. Not until 2002 did the local loop unbundling rule go into effect in this country. Hence some research refers to the case of South Korea before 2002 as an example of success without unbundling (Crandall, 2006).	Substantial number of residential apartments that lend themselves to competing fiber networks connecting to the basements of buildings. As a result these locations have some of the most competitive outcomes for consumers in the world.

Source: adapted from OECD (2013).

Table A1 – Fiber Development and regulatory Approaches within the OECD area (cont'd)

Country	Fiber Infrastructures Deployment	Regulatory Approach
SINGAPORE		The provision of access facilities is structurally separated from the provision of retail services.
HONG KONG		Substantial number of residential apartments that lend themselves to competing fiber networks connecting to the basements of buildings. As a result these locations have some of the most competitive outcomes for consumers in the world.
NEW ZELAND	The government has put in place two initiatives to improve broadband services: the Ultra-Fast Broadband Initiative and the Rural Broadband Initiative. Together, these programmers aim to cover 97.8% of the population. By 2020. The goal is to connect 75% of the population to fiber networks. Schools, hospitals and 90% of businesses will be connected by 2015. Homes and the remaining 10% of businesses will be connected by 2019. Meanwhile, the aim of the Rural Broadband Initiative is to deliver broadband to 252 000 rural households at prices and levels of service comparable with urban areas. In rural areas a combination of copper and fixed wireless infrastructures will be used.	National fiber network is publicly funded structurally The provision of access facilities is structurally separated from the provision of retail services
CHINA		Substantial number of residential apartments that lend themselves to competing fiber networks connecting to the basements of buildings. As a result these locations have some of the most competitive outcomes for consumers in the world
SWITZERLAND		Swisscom is actively engaged in partnerships with utilities in different cities and places to deploy fiber networks, mainly as a competitive response against the growing success of cable operators.

Source: adapted from OECD (2013).

Table A2 – European Regulatory Framework for the Telecommunications Sector (1987- 2000)

Intervention/Drectives	Regulatory Governance
Green Paper on the Development of the Common Market for Telecommunications Services and Equipment (COM(87)290)	Its purpose was to liberalize the markets in telecommunications-terminal equipment, and provide for the abolition of special or exclusive rights to import, market, connect, bring into service and maintain telecommunications-terminal equipment. This was the first step towards the liberalization of all telecommunications markets.
Open Network Provision Directive 1990/387/EC	It has determined the liberalization of voice telephony and infrastructures, with the aim of creating the conditions by which to allow other operators to gain access to national telecommunications networks on fair and non-discriminatory terms, and thereby to compete with the established incumbents, while sharing their infrastructure where necessary. The Directive set the rules for open access to the networks of the old monopolies so that the new entrants could offer services in competition e on equal terms e with the ex-monopolies. This objective of opening the sector to competition led to the introduction of asymmetric regulation: ex monopolies, or incumbent operators, were imposed with obligations that new entrants did not face.
Full Competition Directive Directive 1996/19/EC, amending Directive 90/388/EC.	It has required member states to cease granting special or exclusive rights to national telecommunications operators, as this practice constituted an improper restriction on trade in the internal market. Certain services exempted from the previous Directive 90/388/EC, in recognition of the problems posed by deregulation and the additional time required to find solutions, were finally liberalized. In fact, the main feature of the Full Competition Directive was to require member states to liberalize voice telephony in order to bring to completion the liberalization process of telecommunications services in Europe.
Interconnection Directive Directive 1997/33/EC	It has provided detailed conditions to ensure the open and efficient interconnection of networks as an instrument to foster competition, both in regard to access and to final services to customers. The Interconnection Directive stated that interconnection charges should follow the principles of transparency and cost orientation, implying, amongst other things, the publication of a reference offer and the obligation to keep separate accounts for wholesale and retail operations for all vertically integrated operators.
On the application of open network provision (ONP) to voice telephony and on universal service for telecommunications in a competitive environment Directive 1998/10/EC	It has introduced an obligation for the incumbent to offer bitstream to entrants when it was already available to its own services These rules have since been a milestone for the creation of sustainable competition based on new services, but also (partially) on new infrastructures in the European telecommunications arena.
Electronic Commerce Directive Directive 2000/31/EC	The EC pursued the specific purpose of setting up an internal market for electronic commerce among the member states. The framework aimed to provide common rules regarding: transparency, information requirements for online service providers, commercial communications, electronic contracts and limitations to the liability of intermediary service providers. Nonetheless, these first interventions towards harmonization in Europe were fragmented, as they were directed at selected segments of the whole electronic communications picture.
Regulation on Local Loop Unbundling Directive 2000/2887/EC	The European access regulation progressively included an obligation to offer an interconnection to incumbents' networks at cost oriented prices, and a duty to allow access to essential components of the network, especially as key access regulatory instruments.

Source: adapted from Parcu and Silvestri (2014)

Table A3 – European Regulatory Framework for the Telecommunications Sector (2002)

Intervention/Directives	Regulatory Governance
Framework Directive Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services; (OJ L108/33, 24.4.2002)	It regulates the principles that concern all the activities enclosed in the other specific directives, which constitute the regulatory framework. It focuses above all on the responsibilities and powers of the National Regulatory Authorities, since they are the basis of the new regulatory system. Member States must guarantee effective mechanisms for appeal and dispute resolution, and transposition laws should warrant the suitable completion of the implementation process, mainly the NRAs' first market reviews
Access Directive Directive 2002/19/EC of the European Parliament and of the Council of 7 March 2002 on access to, and interconnection of, electronic communications networks and associated facilities; (OJ L108/7, 24.4.2002)	It delineates the values that should drive the NRAs in applying their powers to supervise and, where necessary, regulate relations between the operators, i.e. the wholesale market. Access and interconnection conditions should be mostly ruled by commercial negotiations, but the NRAs shall still have authority to intervene so that the policy purposes are met. Therefore, NRAs necessitate justifying their decisions to commit market players and the market analysis procedures stated by the new framework offer the means by which they are asked to act. As a result, NRAs benefit from a broad grade of discretion that must be reconciled with the actions of the Commission and the NRAs of other Member States so as to guarantee the application of the regulatory principles across the EU.
Authorisation Directive Directive 2002/20/EC of the European Parliament and of the Council of 7 March 2002 on the authorisation of electronic communications networks and services; (OJ L108/21, 24.4.2002)	It responds to the need of reducing the regulatory burdens on market access and of ensuring a more consistent treatment of operators by generating an official framework, which ensures the free will to provide electronic communications networks and services, subject only to the limited conditions express in the Directive
Universal Service Directive Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users rights relating to electronic communications networks and services; (OJ L108/51, 24.4.2002)	It designs the regulatory setting to safeguard the interests of users, providing national regulatory authorities with the necessary powers in order to minimise market distortions. Obligations should only be obligatory on operators with Significant Market Power (SMP) in a significant retail market not effectively competitive, and where NRAs believe that obligations imposed at the wholesale level and/or carrier selection and pre-selection are not performed under competitive conditions.
Competition Directive Commission Directive 2002/77/EC of 16 September 2002 on competition in the markets for electronic communications networks and services; (OJ L249/21, 17.09.2002)	It requires Member States to eliminate special or exclusive rights relating to electronic communications networks and services (including those involving the use of frequencies) and to ensure that any operator is allowed to offer them, on objective, non-discriminatory, proportionate and transparent criteria. It is worth noting that the *Competition Directive* concerns all networks and services related to the delivery of signals by wire, radio, optical or other electromagnetic means (e.g. fixed, wireless, cable and satellite networks) and to the so-called 'dark–fibre' networks, which enable third parties to transmit signals, using their own switching or routing equipment. It hence applies to transmission networks and services used for broadcasting of radio and television programmes, excluding services providing or exercising control over their content.

Source: adapted from Afonso and Scaglioni (2006)

Table A4 – European Regulatory Framework for the Telecommunications Sector (2007-2013)

Intervention/Directives	**Regulatory Governance**
Roaming Regulation 2007/717/EC, amending Regulation 2009/544/EC	The EC first intervened to broaden access and cut down roaming charges, imposing a price cap, the so-called *Eurotariff*, both at wholesale and at retail level, and required more transparency in the information given to customers for voice-call roaming prices. The 2007 intervention was meant to be exceptional and temporary, so that if normal market conditions were re-established in the market for roaming calls afterward, the regulation would expire in three years. The Commission, together with the national regulatory authorities, monitored the development of the prices, and the price cap was extended to text messaging and to data traffic in 2009
Establishment of BEREC Regulation CE No. 1211/2009	BEREC was set up with the aim of improving and unifying the implementation of the European regulatory framework, providing advice to the Commission and member states, promoting greater harmonization, and improving collaboration and discussion among national regulatory authorities, the Commission and the stakeholders. The institution of BEREC can be interpreted as a step towards a more centralized and cooperative structure of electronic communications regulation in Europe, and also as an instrument that can serve to strengthen a peer-review activity that would continuously monitor the status and functioning of European regulation in the individual states.
NGA Recommendation 2010/572/EU	It acknowledges the need to take into account the fact that the transition from copper-based to fiber-based networks may change the competitive conditions in the different geographical areas. Consequently, geographically differentiated remedies should be applied where appropriate.
Roaming Regulation 2012/531/EC	It extends the price ceilings at both wholesale and retail levels for voice, text messaging and mobile Internet, with the aim of bringing down the difference between national and roaming tariffs to virtually zero by 2015.
Connected continent: building a telecom single market September 11, 2013	The EC adopted an important legislative package, containing proposals for overcoming several obstacles: for example, in terms of issues related to operators wanting to operate across borders (that is, in more than one member state), it seeks to introduce a one stop- shop authorization system. This includes the "three-criteria test" in all cases where NRAs have to choose in which market to intervene, and requires a full harmonization of consumer protection rules. Regarding spectrum, it promotes spectrum sharing and spectrum trading. It demands common regulatory principles for spectrum-authorization procedures, and harmonization of the timing and duration of spectrum assignments for wireless broadband across countries. It guarantees net neutrality across Europe, and further stresses the need to bring roaming prices down to domestic price levels by 2016. However, the package, does not seem to radically change the existing regulatory framework for electronic communications in Europe. The main aim of the package is to lighten the regulatory burden and eliminate unwanted market obstacles towards a single digital market in Europe.
NGN Regulation Recommendation 2013/5761/EC	The objectives of this document are: to provide for pricing flexibility of NGN services; to ensure effective non-discrimination and sufficient competitive constraints; to guarantee predictable and stable regulated wholesale-copper access prices that are consistent with the principle of cost orientation; and to ensure a level playing-field between incumbent and alternative operators through the implementation of effective and proportionate non-discriminating obligations that facilitate downstream competition. The recommendation applies the principle of the Equivalence of Inputs in order to guarantee non-discrimination between incumbent and alternative operators. Regarding the possibility of a price squeeze, the draft recommendation says that the NRA can decide whether to use an Equally Efficient Operator or a Reasonably Efficient Operator standard, to ensure that the offers made by the incumbent operator are technically replicable by alternative operators. The most controversial aspect of the recommendation is that it fixes a price interval for the monthly fee of LLU e between 8 and 10 euros e with the intent to stabilize this price in the long term.

Source: adapted from Parcu and Silvestri (2014)

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