

## **Regulation and Investment in European Telecoms Markets**

Prepared for the European Competitive Telecoms Association

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### **Abstract**

The European Union Directives regulating the electronic communications sector call for harmonised regulation and on national regulatory authorities to encourage efficient investment in infrastructure.

However, there is strong evidence that the new regulatory framework has been implemented inconsistently across the EU and that levels of investment per capita vary substantially, from \$40 per capita in Poland to over \$200 in the UK. Using separate measures of regulatory effectiveness and reform developed by the European Competitive Telecoms Association and by the OECD, this paper seeks to establish whether there is a relationship between regulation and investment. We develop cross-sectional, lagged and pooled time-series/cross-section regression models using investment per capita as the dependent variable and a measure of regulation as one of the explanatory variables. In all model specifications we find a significant and positive relationship.

## 1. Executive Summary

The European Union (EU) Directives forming the New Regulatory Framework (NRF) for the electronic communications sector seek to establish harmonisation of regulation throughout the EU. The NRF sets out objectives for National Regulatory Authorities (NRAs) including “encouraging efficient investment in infrastructure and promoting innovation”<sup>1</sup>.

It has long been recognised that the actions of the state, including regulators, can have a significant impact on firms’ incentives to invest. For this reason, many scholars have sought to measure regulatory effectiveness and study its impact on key economic outcomes, such as penetration of mainlines, employment and investment in the sector.

The three largest economies in the EU (France, Germany and the UK) present divergent case studies of regulation and investment.

- In 2003, France \$102 invested per capita, slightly below the EU average of \$109 per capita. By 2005, French investment at \$129 per capita was above average the average of \$114. Over the same period, its regulation changed significantly and, according to the European Competitive Telecoms Association (ECTA) Regulatory Scorecard, its ranking improved from 8<sup>th</sup> to 3<sup>rd</sup><sup>2</sup>.
- Germany’s investment record is not so good: it invested \$75 per capita in 2003 and \$99 per capita in 2005. Its Scorecard ranking was 10<sup>th</sup> in both years.
- The UK has consistently invested well above the EU average (\$184 and \$220 in 2003 and 2005) and has always ranked first in the ECTA Scorecard, with a strong record on its institutional structures and competition in telephone and business services.

In the earliest version of the Scorecard, Germany was relatively strong on procedural aspects of regulation and in its timely introduction of the EU Framework in place at that time, although it was considered weak on some other areas. France was seen as weaker than Germany on most aspects of regulation including institutionally and with regard to its implementation of economic regulation. However, by 2005, and even more so in 2006, France had made enormous progress both institutionally and through its active efforts to promote competition in broadband and business services. By contrast, Germany had slipped back with concerns raised over delays in implementing and applying key aspects of the current EU Framework. The UK remained strong on nearly all aspects of regulation over the whole period, though it lagged behind France and Germany on its implementation of local loop unbundling – a key enabler of broadband competition. Since 2005 and

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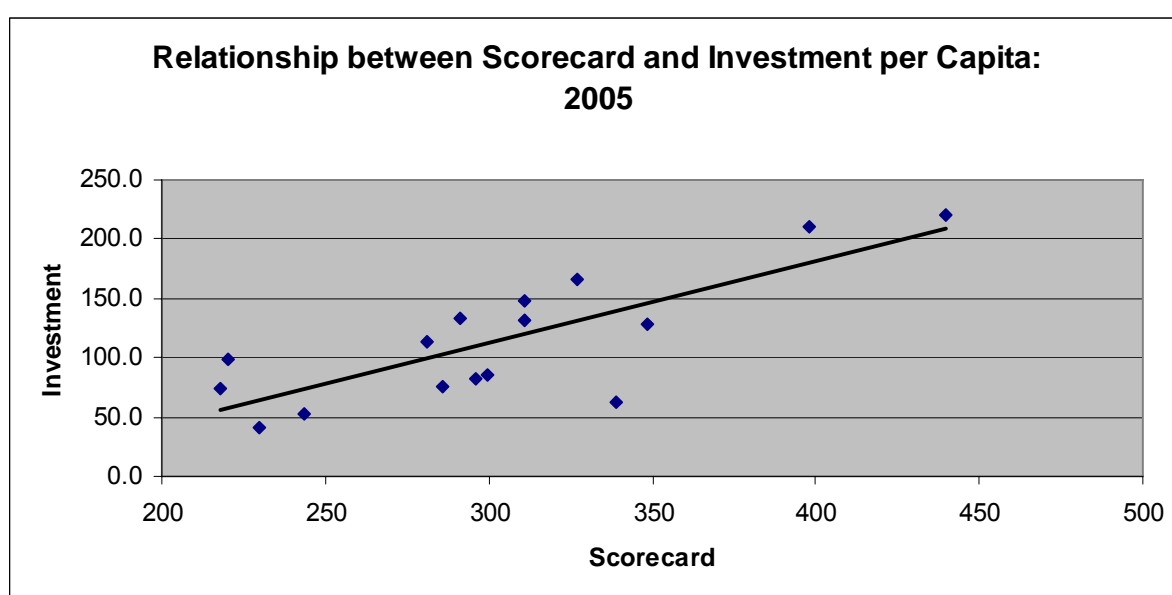
<sup>1</sup> Framework Directive, Article 8.2

<sup>2</sup> Rankings refer to the position of countries amongst the ten Member States included in the 2003 Scorecard: Belgium, Denmark, France, Germany, Ireland, Italy, Netherlands, Spain, Sweden and UK.

the conclusion of Ofcom's Telecoms Strategic Review, the UK has consolidated its position by addressing its weaknesses in unbundling, stimulating investment by competitors and the development of, and demand for, higher speed services which in other countries was the precursor to further investments in the local access network.

Looking across a wider sample of countries, we see a strong correlation between investment per capita overall and the results of the Scorecard. Figure 1 plots the relationship between investment per capita in 2005 and the Scorecard results for the same year. The coefficient of correlation is 0.79 for all 15 countries. Even excluding the two extreme countries (UK and Greece) we still find a strong relationship of 0.69.

**Figure 1: Relationship between Regulation and Investment 2005**



In this paper we present three new econometric models of the relationship between investment and regulation. Allowing for countries' wealth, size and economic climate, we find:

- A significant, positive, relationship between the level of investment and the ECTA Regulatory Scorecard in both 2003 and 2005.
- Our models show a coefficient on the logged value of the Scorecard variable of between 1.37 and 1.67 at 5% significance.
- The first evidence of causation between regulation and investment by developing a model which uses Scorecard results two years before investment.
- We have tested our models for robustness using an independent measure of regulation: the OECD's Regulatory Reform Index. Using this measure we also find a significant, though somewhat weaker relationship between regulation and investment, with a coefficient of between -0.50 and -0.59<sup>3</sup> at 5% significance.

<sup>3</sup> In the OECD RRI, lower scoring countries have more effective regulation, hence the sign on the coefficient is negative.

These findings concur with the a study conducted by London Economics on behalf of the European Commission, which also found a significant relationship between investment and regulation, though are stronger as we have been able to develop a lagged model using regulation two years before investment.

We conclude that an effective regulatory environment which supports competition is strongly associated with higher levels of investment. The European Commission, national governments, and NRAs therefore need to continue to ensure that barriers to sustainable market entry are removed, consumers are empowered to exercise choice and owners of bottleneck assets are not allowed to discriminate in favour of their own downstream (retail) operations.

## 2. Public Policy Context

The purpose of the regulator is not to regulate for its own sake, but to promote some social outcome desired by government. This paper seeks to measure how effective regulatory environments have been at promoting outcomes. The question is what outcome or outcomes do we and can we measure?

Brown et al (2006, p 160 - 164) list 41 measures of relevant outcomes and criteria for infrastructure industries clustered into eight groups:

- Indicators for Output and Consumption
- Indicators for Efficiency
- Indicators for Quality of Supply
- Indicators for Financial Performance
- Indicators for Capacity, Investment, and Maintenance
- Indicators for Prices
- Indicators for Competition
- Social Indicators

We cannot in the scope of this paper measure all the outcomes listed above. To help select a single measure, we refer to the New Regulatory Framework (NRF) for the electronic communications sector passed by the European Council and Parliament in 2002. Article 8.2 of the Framework Directive sets the objectives for National Regulatory Authorities (NRAs) and so helps to select the outcome to be measured:

*The national regulatory authorities shall promote competition in the provision of electronic communications networks, electronic communications services and associated facilities and services by inter alia:*

- (a) ensuring that users, including disabled users, derive maximum benefit in terms of choice, price, and quality;*
- (b) ensuring that there is no distortion or restriction of competition in the electronic communications sector;*
- (c) encouraging efficient investment in infrastructure, and promoting innovation*

Note that NRAs are required to encourage “efficient investment”. Economics recognises three types of efficiency: allocative efficiency, productive efficiency and dynamic efficiency. When NRAs encourage investment, it is allocative efficiency which is of most relevance<sup>4</sup>.

The relevance of allocative efficiency is that it refers to prices being set at cost (including a reasonable margin) so that demand, and therefore investment incentives, are not distorted thereby encouraging inefficient investment or discouraging efficient investment. Suppose that the price of a regulated input, say unbundled local loops, was set above the cost of supply. This would artificially depress demand, and may also encourage inefficient investment in alternative infrastructures, if the cost such an alternative was below the regulated price of unbundled local loops but above their real cost. The opposite would happen if the regulated price were set below cost: demand would be artificially increased whilst investment in alternatives artificially suppressed. To encourage efficient investment, therefore, regulators need to ensure the cost of electronic communications networks and services are revealed, either through competition or regulatory action.

Investors, of course, need to be reasonably sure that they can earn a return on their investment commensurate with their level of risk. In turn, this requires a regulatory environment which does not discriminate in favour of a competitor rather than competition, and does not attempt to expropriate profit. In short, regulation must credibly satisfy the needs of both consumers and investors (Newbery, 2001).

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<sup>4</sup> Productive efficiency refers to producing current goods and services at the lowest possible cost and dynamic efficiency refers to innovation in products and services.

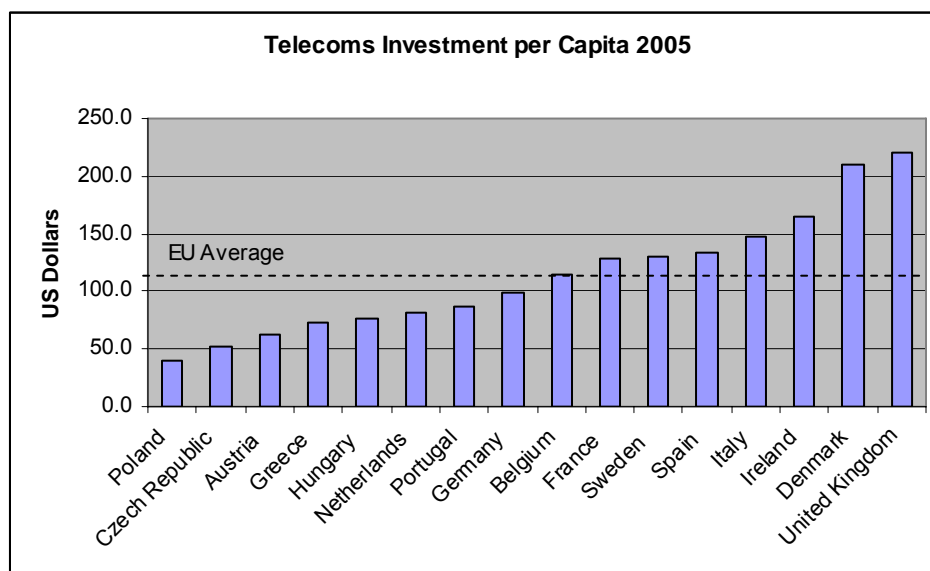
Other possible measures of outcome, based on Article 8.2, could be choice, quality or price. The first two are likely to be the result of investment in new products or services which create more choice and better quality customer experience. Price is highly likely to be affected by regulation itself through retail and/or wholesale price caps imposed by the regulator. Where prices are unaffected by regulation, i.e. in fully competitive markets, they may be affected by investment either by new competitors increasing competition in the market or by existing players investing in new products and services. For all these reasons, we have chosen investment as our outcome for analysis. It may be possible in the future to extend our analysis to other market outcomes.

That the state can affect the behaviour of firms has long been established in economic literature. Stigler (1971) recognised the power of the state to help or hurt industry. More recently, Melody (2003) spelt out the power of regulation to affect investment decisions:

*We know from experience that credible (i.e., competent, objective, transparent and accountable) regulation is a great attraction for new investment. Expedient interconnection regulation is a key element in attracting new investment. Asymmetric cost-based termination prices will attract investment to previously unserved high cost areas by making them potentially financially viable. Governments (or regulators) using their monopoly power to auction licenses and spectrum on the basis of up-front cash payments of monopoly prices will suck investment capital out of the industry. The risk of unilateral imposition of unjustified fees and charges on industry players reduces incentives to invest. Barriers to entry to protect incumbent operators reduce both their incentive to invest and the investment opportunities of potential new entrants. Indeed most decisions by regulators affect the investment climate in their countries.*

Allowing for variations in population and economy size, investment levels in telecommunications across the EU vary considerably, as shown in Figure 2. For example, in 2005 Poland invested \$40 per capita compared with the UK which invested \$220 per capita (OECD 2007).

**Figure 2: Telecoms Investment per Capita<sup>5</sup>**



The NRF also seeks to promote harmonised regulation throughout the EU to support the single market. This objective is set out in Article 1.1 of the Framework Directive:

*This Directive establishes a harmonised framework for the regulation of electronic communications services, electronic communications networks, associated facilities and associated services. It lays down tasks of national regulatory authorities and establishes a*

<sup>5</sup> The sixteen EU countries shown in this graph are those in the 2005 ECTA Scorecard. The average refers to the average of these sixteen countries.



*set of procedures to ensure the harmonised application of the regulatory framework throughout the Community*

Several authors have examined the degree of harmonisation across EU regulatory institutions and regimes (see for example: Edwards & Waverman 2006, Gaul and Trillas 2006 and OECD 2006). Of particular interest to this paper is the ECTA Regulatory Scorecard (hereafter the Scorecard), produced by Beaufort International and Jones Day (2002) and by ECTA, Jones Day, SPC Network (2004, 2005, 2006), which demonstrates that the application of regulation is not harmonised and that substantial differences exist between EU Member States as to how effectively they have implemented the NRF.

This paper explores the relationship between regulation and investment. We wish to examine whether the variation in the level of investment across the whole telecommunications sector is significantly related to the variation in the effectiveness of national regulatory environments.

This paper is organised as follows: Section 3 introduces two measures of regulation used in the paper: the Scorecard and the OECD's Regulatory Reform Index (RRI). Section 4 presents case studies of regulation and investment in the three largest telecoms markets in the EU: France, Germany and the UK. Section 5 reviews previous literature on the relationship between regulation and investment and discusses the theoretic foundations of the later analysis. Section 6 presents our model of regulation and investment. Section 7 concludes and discusses the implications for policy makers.

### 3. Measuring Regulatory Effectiveness

In this paper we refer to two indices which have been constructed to measure regulatory effectiveness: the ECTA Regulatory Scorecard and the OECD Regulatory Reform Index (RRI). This section provides a brief introduction to each methodology.

#### 3.1 The ECTA Regulatory Scorecard

The Scorecard was first published in 2002, since when three further versions have been produced covering regulation in 2003, 2005 and 2006. The Scorecard measures the effectiveness of the telecoms sector regulatory regime in a number of EU countries. It began with nine countries in 2002 and covered 17 by 2006 reflecting the authors' experience in producing the Scorecard and the increased size of the EU. The forthcoming 2007 Scorecard will be extended to cover 19 countries.

The principal purpose of the Scorecard is to compare the performance of the regulatory regimes across Europe at promoting sustainable competition through ensuring that entrants can gain access to bottleneck facilities on non-discriminatory terms and that regulated prices promote the "ladder of investment" theory, whereby entrants are encouraged to become less reliant on the incumbent for key inputs.

The Scorecard is calculated by measuring regulatory regimes across a broad swathe of criteria. The number of criteria, and the criteria themselves, change as the market and regulation develop. In 2002 there were 52 criteria. By 2006 there were 99. Each criterion is allocated a weight, or maximum possible score. Then each country is scored against that criterion where the highest score is awarded to the best performing countries and zero to the worst performing. It is possible for all countries to receive the highest possible score for a given criterion. For example, if all countries have implemented Carrier Selection/Pre-Selection, then all would be awarded full marks. The scores for each criterion are summed to calculate the total score for each country.

The criteria are grouped into Sections covering the powers and processes of the regulator and the dispute settlement authority, general access conditions and specific products. The hierarchy for the 2005 Scorecard is shown in Figure 3.

The Scorecard presents the strengths and weaknesses of countries through a graphic known as the "traffic lights": strengths are coloured in green, weakness in red and intermediate areas in amber.

In this paper we use the results of the 2003 and 2005 Scorecards to coincide with investment data available from the OECD. A fuller description of the Scorecard methodology is contained in ECTA, Jones Day, SPC Network (2005).

#### 3.2 The OECD Regulatory Reform Index

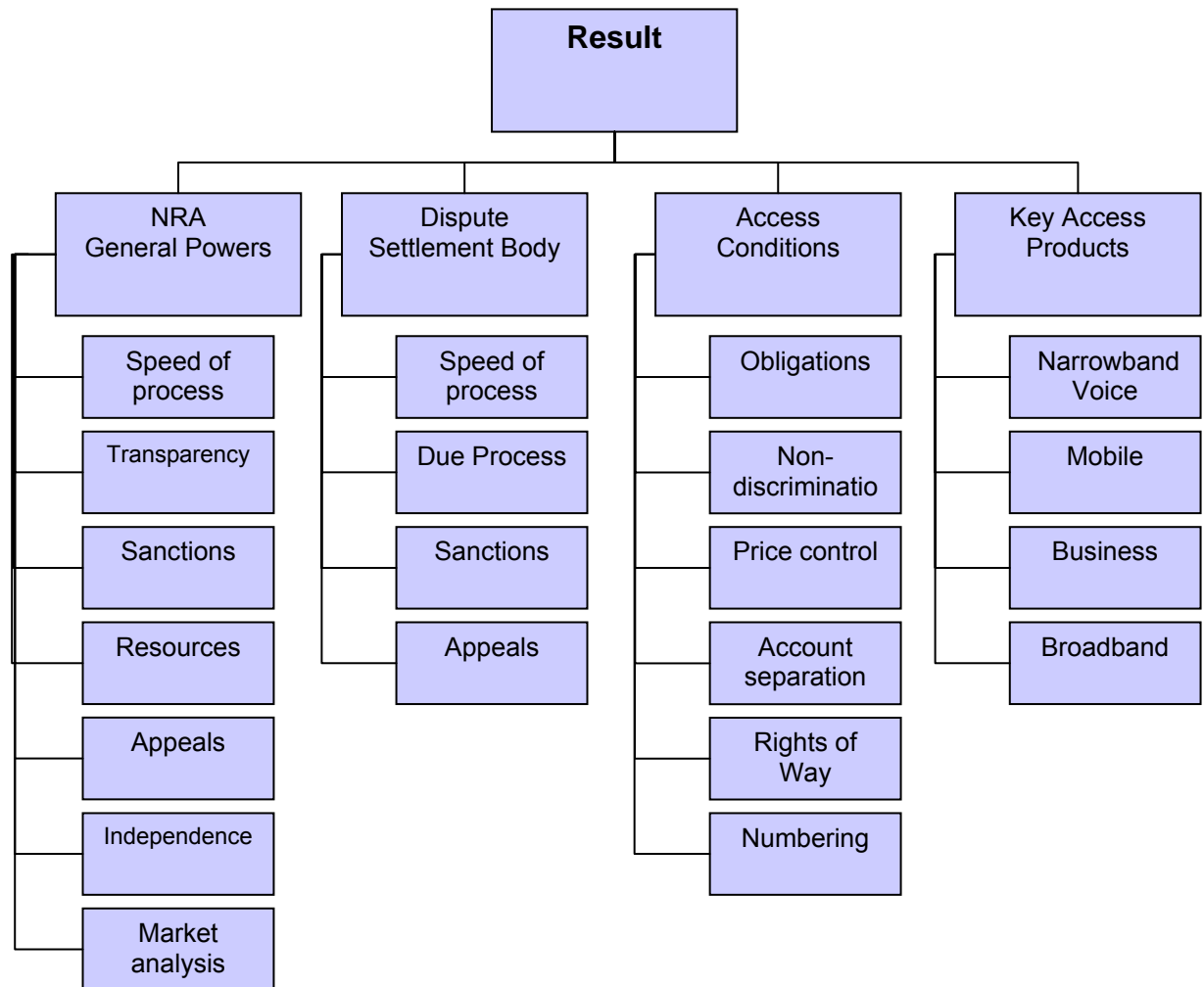
The Organisation for Economic Co-operation and Development (OECD) has developed its own Regulatory Reform Index (RRI)<sup>6</sup>. The RRI includes a range of indicators of product market regulation at both the economy-wide and sectoral levels. All of these indicators measure the extent to which policy settings promote or inhibit competition in areas of the product market where competition is viable. A subset of the overall RRI covers energy, transport and communications regulation (ETCR), within which are data on reform in telecommunications.

The telecommunications sector of the RRI has three main sections: entry regulation, public ownership and market structure covering eight criteria. It is less comprehensive than the ECTA Scorecard, but places more weight on contestability, through market entry, and competition in the market. Figure 4 shows the structure of the telecommunications section of the RRI and how scores are awarded. In contrast to the ECTA Scorecard, a low score is attributed to countries with the "best" regulatory environment. A fuller description of the RRI can be found in Conway and Nicoletti (2006).

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<sup>6</sup> Available at [www.oecd.org/eco/pmr](http://www.oecd.org/eco/pmr)

Figure 3: The ECTA Regulatory Scorecard

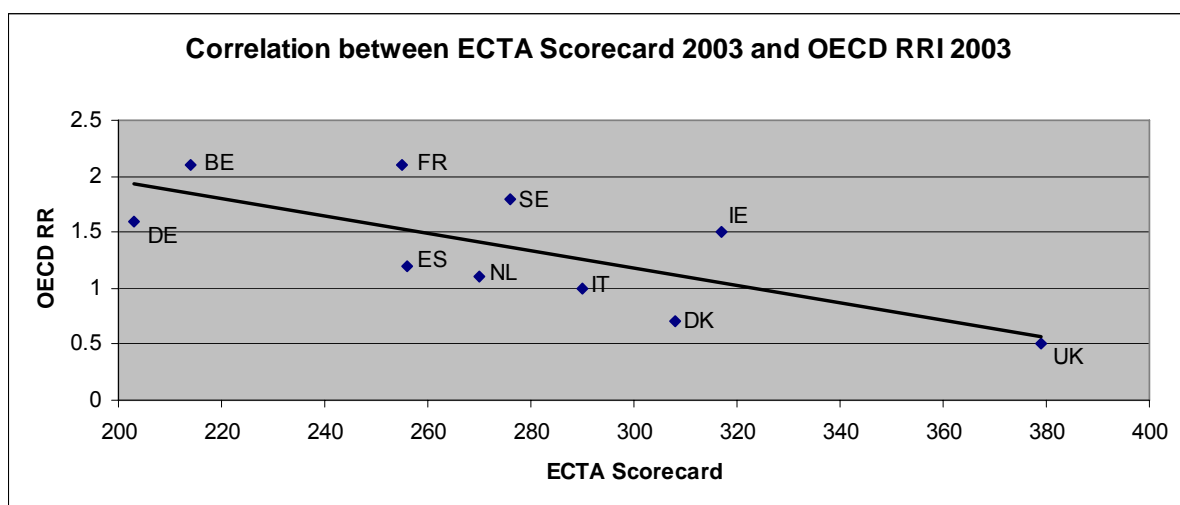


**Figure 4: The OECD Regulatory Reform Index**

	Weights by theme (b <sub>i</sub> )	Question weights (c <sub>k</sub> ) <sup>1</sup>	Coding of data		
			Free entry	Franchised to two or more operators	Franchised to 1 firm
<b>Entry regulations</b>	1/3				
What are the legal conditions of entry into the trunk telephony market?		$\frac{1}{4} * w^t * (1 - w^m)$	0	3	6
What are the legal conditions of entry into the international market?		$\frac{1}{4} * (1 - w^t) * (1 - w^m)$	0	3	6
What are the legal conditions of entry into the mobile market?		$\frac{1}{2} * w^m$	0	3	6
<b>Public Ownership</b>	1/3				
What percentage of shares in the PTO <sup>2</sup> are owned by the government?		$1 - w^m$	% government ownership / 100 * 6		
What percentage of shares in the largest firm in the mobile telecoms sector are owned by the government?		$w^*$	% government ownership / 100 * 6		
<b>Market Structure<sup>3</sup></b>	1/3				
What is the market share of new entrants in the trunk telephony market?		$\frac{1}{4} * w^t * (1 - w^m)$	6 – normalised market share		
What is the market share of new entrants in the international telephony market?		$\frac{1}{4} * (1 - w^t) * (1 - w^m)$	6 – normalised market share		
What is the market share of new entrants in the mobile market?		$\frac{1}{2} * w^m$	6 – normalised market share		
Country Scores (0-6)			$\sum_i b_i \sum_k c_k \text{ answer}_{ik}$		

Whilst the Scorecard and the RRI are independently produced, there is a strong correlation between the two. Figure 5 plots the results from both indices of regulation. The coefficient of correlation is 0.72.

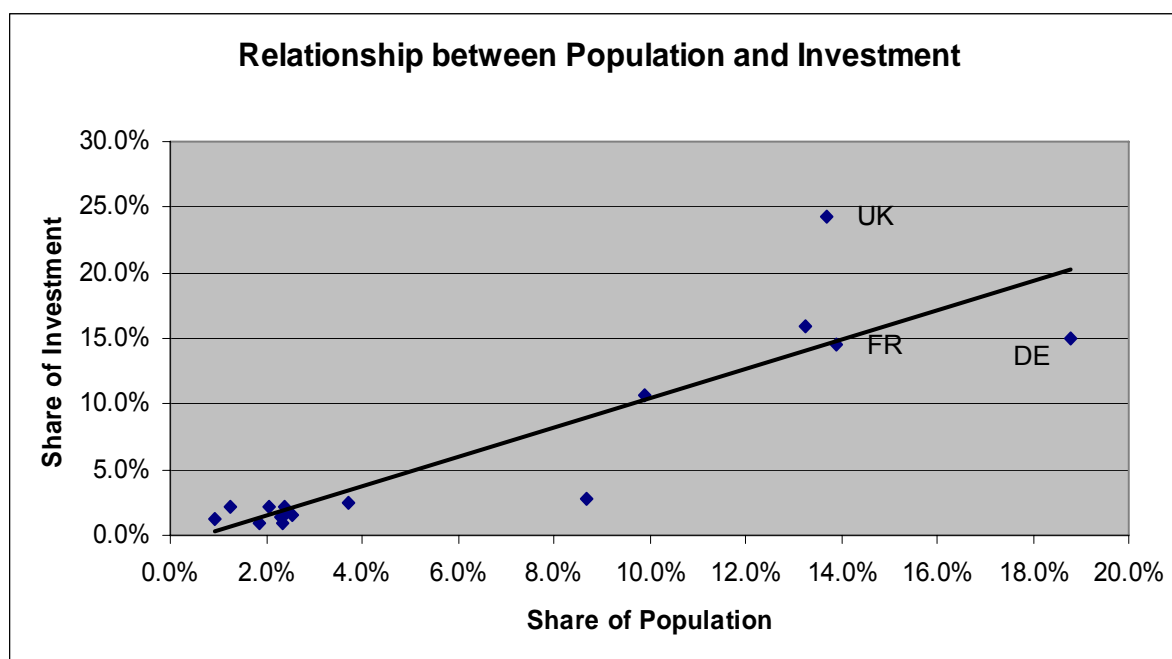
**Figure 5: Correlation between Scorecard and RRI**



#### 4. Case Studies of Regulation and Investment

In this section we present three brief case studies of the relationship between investment and regulation in the three largest EU economies: France, Germany and the UK. As well as being the largest economies in the EU, these three countries present contrasting characteristics. France and Germany have seen a near reversal of their Scorecard positions since 2002, whilst the UK has consistently been the top scorer. The UK invests considerably more than its population<sup>7</sup> would suggest, Germany considerably less whilst France invests the amount expected given its population. Figure 6 plots percentage of total investment against percentage of total population for each of the 16 2005 Scorecard countries. The positions for France, Germany and the UK are highlighted.

**Figure 6: Relationship between Population and Investment**



In these brief case studies we report on the performance of three countries in the Scorecard together with some further commentary.

##### 4.1 France

Rank	2002	2003	2005	2006
ECTA Scorecard	8	8	3	3
Investment per capita	7	8	7	
Investment as percentage of GDP	6	7	8	
Sample	9	10	16	17

*France has seen a marked improvement in its Scorecard ranking, jumping from 8<sup>th</sup> place in 2003 to third place in 2005 and again in 2006. Its investment position has not improved with the same speed. However, there is evidence that the amount of investment continues to grow strongly in France.*

The French national regulatory authority, ARCEP, views regulation in France as having been through three phases (ARCEP 2007). The first phase lasted between 1997 and 2001 and concentrated on liberalisation and opening the market to competition. Phase two ran from 2001 until 2004 and is described by ARCEP as the “turning point” when ART, ARCEP’s predecessor, began to concentrate its efforts on unbundling in the local loop and promoting broadband. The third and current phase

<sup>7</sup> Population is a standard means of normalising investment data. In the later econometrics which begin to measure changes in investment and regulation over time, population is useful normalising factor as it remains largely constant.

ARCEP terms “New Regulation” and follows the implementation of the NRF is dominated by mobile and broadband.

The first phase of regulation concentrated mostly on the fixed calling market and the implementation of mechanisms to promote competition such as Carrier Pre-Selection (CPS) and Number Portability (NP). The focus on fixed telephony was not surprising given that it represented, according to ARCEP, around 75% of the total telecoms market. The Internet, the focus of much of the later phases of regulation, was under-developed with just 500,000 homes connected via dial-up modems.

By the early 2000’s competition, as it was envisaged in 1996, remained “fragile” (ARCEP 2007 p46). Competition was confined to the calling segment and there was little competition in the local loop. Broadband was just beginning to enter the market and ART was inspired by the success of broadband observed in countries such as Korea and Japan. It therefore began aggressively to regulate local loop unbundling, forcing down prices, so as to promote competing alternative networks (Krafft 2006). At the same time wireless local loop licences were awarded to stimulate entry into fixed access markets.

The third and current phase of regulation followed the entry into force of the NRF which passed into French law in 2004. ARCEP’s Decisions of 6<sup>th</sup> June 2005 set a clear framework for unbundling and bitstream regulation and the nature of the obligations applied in these markets enabled a reconciliation between creating incentives to deploy unbundling and the necessary use of bitstream in sparsely populated areas (ARCEP 2007 p61). It is therefore perhaps not surprising that France has the highest proportion of DSL lines provided by LLU operators (34%) of any country in the EU (ECTA 2007).

Unlike other European countries, France is experiencing competition for, and substantial growth in, the market for Fibre to the Home (FTTH) networks. Ofcom (2007a, p20) attributes the burgeoning FTTH market in France to established broadband competition together with low build costs due to the extensive sewer network in Paris which is being used to lay fibre. Certainly France had a competitive broadband market before the first announcement regarding FTTH was made in January 2006. Of the 25 countries surveyed by ECTA for its Broadband Scorecard, France had the fourth least concentrated market based on the market share of different broadband technologies. Since then, a number of announcements have been made by three operators developing FTTH as shown in Figure 7.

**Figure 7: FTTH Announcements in France**

Date	France Telecom	Free (Iliad)	NeufCegetel
January 2006	Announces plan to offer FTTH in Paris and Haut-de-Seine as from the summer of 2006.		
July 2006	Begins testing FTTH in Paris.		
September 2006		Announces FTTH roll-out in Paris and €1 billion investment, to be available in first half of 2007. Plans to pass 10 million homes by 2012	
December 2006	Announces early stage deployment during 2007 – 2008 and roll out to cities outside Paris		
March 2007			Announces FTTx to be available in Paris from April 2007 and plans to pass one million

			homes by December 2009 with investment of €300m
April 2007			Announces FTTH available in Pau, SW France.
May 2007			Signs deal with estate agents grouping to promote FTTH.
August 2007		Announces launch of FTTH product in mid-September.	

(Source: Company reports and press releases.)

In 2002, 12 of the 18 areas of the Scorecard were identified as weaknesses in France. By 2006 this had fallen to just two of 18. In 2002 all four areas related to access products (Voice interconnection, PPC's and Leased Lines, Wholesale DSL and LLU) and the five areas related to access regulation (cost orientation, cost accounting and separation, availability of information, satisfaction of requests and rights of way) were weaknesses. By 2006 France only remained weak on "general access and policy procedure" from the equivalent ten criteria groups.

The OECD's investment data show a steady increase of around 13% per annum in investment between 2002 and 2005 from \$5.4 billion to \$7.8 billion. ARCEP shows that growth continuing with a further 10.5% growth between 2005 and 2006. So whilst France's investment ranking lagged behind its Scorecard ranking in 2005, future data on investment may well see investment catch up with regulation. France now invests at about the level expected given its share of population. In 2002, its share of investment amongst the 16 countries in the 2005 Scorecard was 11%, whilst its share of population was 14%. By 2005 its share of investment was 14.5% whilst its share of population remained static.

#### 4.2 Germany

Rank	2002	2003	2005	2006
Scorecard	3	10	15	15
Investment per capita	8	10	9	
Investment as percentage of GDP	8	10	12	
Sample	9	10	16	17

*Germany has fallen from 3<sup>d</sup> place in the Scorecard in 2002 to near last in 2005 and 2006. Its investment ranking was somewhat higher in 2005 though most of countries below it were from New Member States.*

When Germany first opened its telecoms market to competition on January 1<sup>st</sup> 1997 it did so with a big bang, implementing most of the key regulatory decisions that were introduced slowly and sometimes painfully elsewhere, with immediate effect. Deutsche Telekom saw its market share erode rapidly as consumers switched to alternative operators on a call-by-call basis. Hence in 2002, when the Scorecard was strongly weighted towards voice interconnect issues, Germany scored highly.

However, since then Germany's position has slipped as fast as France's has risen. Indeed by 2005, Germany was being described as a "liberalisation laggard" (Deutsche Bank 2005). Germany was one of the last of the EU15 Member States to transpose the NRF into national law, eventually passing the Telecommunications Act in May 2004 for entry into force on 26<sup>th</sup> June 2004, over eleven months after the deadline agreed by the European Council.

Although Germany has been successful at promoting broadband access based on LLU, in April 2007, Germany adopted a law which could allow DT a regulatory holiday on its VDSL network in spite of its dominant position in the broadband market. At the time of writing the German government was in dispute with the European Commission over this development. The Commission began proceedings

against Germany in February 2007 and in May issued a “reasoned opinion”, the second stage in such proceedings.

In the meantime, the German regulator, BNetzA, has taken two decisions which suggest that it may not think that DT would be justified in having a regulatory holiday. In June 2006, BNetzA announced that it still considers DT to have Significant Market Power (SMP) in the market for unbundled local loops (Market 11) and that it would therefore continue to have to provide access to metallic loops on the same terms. In addition DT will have to open up to competitors its cable conduits (ducts) between the main distribution frame and the street cabinet, and in limited cases, if access to the cable conduits is not possible for either technical reasons or for lack of capacity to grant access to dark fibre for backhaul<sup>8</sup>. Further, BNetzA has determined that VDSL is not in a new market but in the same economic market as ADSL bitstream and so DT is not justified in having a regulatory holiday over VDSL. DT however is appealing the decisions and has not implemented a reference offer.

In 2002, Germany had six of the 18 segments of Scorecard coloured green (strengths) and eight coloured red (weaknesses). By 2006, just four were green, and nine of 18 segments were red. In 2002, RegTP was considered to have a strength in its independence from both government and the incumbent operator. By 2006, independence was seen as a weakness as a result of the limitations on BnetzA’s discretion under the legislation and the ability of the Ministry of Economy and Technology (BMWi’s) to instruct BNetzA. Furthermore, weaknesses affecting the effectiveness of the regulator and certainty for market powers were identified in BnetzA’s enforcement powers and in the appeals process.

In 2002, Germany was expected to score highly on the implementation of the NRF. By 2006, it was considered to have scored poorly due to the late implementation of the NRF into national law and the number of proceedings that were open at the time of Scorecard.

By contrast, in the 2002 Scorecard Germany scored poorly in the section on Rights of Way (ROW) but had substantially improved by 2006.

Germany’s decline in regulatory effectiveness has been more pronounced than the decline in its investment ranking. In 2002, Germany was investing less than the Scorecard would predict but by 2006 it was investing somewhat more. Between 2002 and 2003, Germany’s investment fell by 7.75%. Whereas in 2002, Germany represented 13.9% of all investment in the 16 countries covered in the 2005 Scorecard, by 2003 this had fallen to 12.8%, well below Germany’s 19% of population. Although investment has improved in Germany since 2003, at 15.1% it is still comfortably below its share of population.

### 4.3 United Kingdom

Rank	2002	2003	2005	2006
Scorecard	1	1	1	1
Investment per capita	1	1	1	
Investment as percentage of GDP	1	1	1	
Sample	9	10	16	17

*The United Kingdom has consistently “top scored” on both the Scorecard and investment, normalised for the size of the economy. It has also consistently invested ahead of both its population size and GDP, although until recently, local loop unbundling was a relative weakness.*

As the first country to begin the process of liberalising, in 1984, the UK the most established regulatory institutions, which is reflected in its consistent strong performance on issues in the Scorecard such as transparency, independence, resources of the regulator and appeals procedures. Its long record of economic regulation supporting competitive entry has led to a relatively strong competitive environment in voice telephony, mobile and business services. However, the UK has lagged behind key competitors, including France and Germany in relation to its poor implementation of local loop unbundling, a key enabler for broadband competition.

<sup>8</sup> BNetzA press release 27<sup>th</sup> June 2007.



The UK's approach to stimulating competition in broadband access has been through three phases. Initially, UK policy makers saw infrastructure competition via cable as the main competition to BT. In 1987 Windsor Telecom, a cable TV franchisee, obtained a determination from the then regulator (OfTel) which allowed it to provide telephone services, albeit in conjunction with Mercury, the only licensed competitor to BT at that time. It was not until July 1993 that the first group of cable TV franchisees was granted licenses to offer voice telephony in their own right.

BT launched its commercial ADSL service in July 2000, one month later than the median for the European Union. Although there is no publicly available concrete evidence, the generally accepted view of the industry is that BT's roll-out of DSL mapped onto the cable footprint, which was also being upgraded to provide broadband services. Similarly, BT's prices responded to pressure from cable companies, as did the access speeds at which broadband was offered.

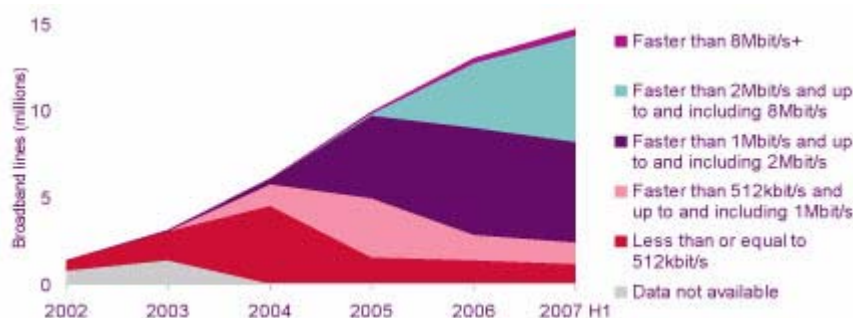
From the launch of broadband in 2000 until the summer of 2002 the two remaining cable operators (ntl and Telewest) were outselling BT. After then, however, the market share of BT began to rise at the expense of cable. At the same time, cable companies faced financial difficulties (both firms taking protection from creditors under Chapter 11). The regulatory emphasis began to switch from wholly independent infrastructure competition to service based competition using bitstream access, the second phase of regulation.

Internet Service Providers reselling BT's wholesale products, steadily increased their share from 15.6% at the start of 2002 to 48% by 2006. Within this sector, there is intense competition. The European Commission reports that there are 780 resale agreements in the UK: more than the rest of the EU combined (European Commission 2006 Annex II, Table 1). However, the limitation of pure resale (and to a lesser extent bitstream) is that retailers are unable to introduce much differentiation in the product offering as the capabilities of the underlying product are to a significant degree controlled by the dominant provider, restricting competition to price, branding or overlaid service offerings, although the latter can nonetheless be valuable in the case of business services.

The third phase of regulation began with Ofcom's Telecoms Strategic Review in 2004/2005 which recognised this problem and identified specific weaknesses in the market that were restricting competitive development, particularly in the residential broadband market in comparison with other EU countries such as France and Germany. Ofcom subsequently implemented a review of the Wholesale Local Access Market (Market 11) and put in place institutions, such as the Office of the Telecoms Adjudicator, to promote local loop unbundling. It also implemented the quasi-structural remedy of Functional Separation to ensure BT's downstream competitors received equivalent services to BT's own retail divisions.

The effect of Ofcom's actions can be seen in, for example, the headline broadband access speeds offered by service providers which has increased steadily and substantially (Figure 8). LLU service providers can install their own equipment at the exchange and so decide for themselves the speed at which customers can access the Internet. As LLU has become a larger part of the market, slower broadband speeds have declined both proportionately and absolutely as competitors invest in DSLAMs offering faster access of up to 8Mbit/s.

**Figure 8: UK broadband connections by headline connection speed**



Source: Ofcom 2007b

Investors have responded to the relatively friendly conditions in the UK by continuing to invest. Investment in the UK has grown at 9% per annum on average between 2002 and 2005. In 2002 it represented 21% of all EU investment, and by 2005 this had grown to over 24%, compared with 14.5% of EU population.

Although financial data are not yet available on investment since 2005, the evidence points to increased investment activity in the industry. At the start of 2006 there were around 142,000 fully unbundled lines and a further 213,000 partially unbundled lines. By the end of 2006, there were over one million unbundled lines in total and recent figures from Ofcom show that this reached 3.195m in September 2007. Over this same period competitors rolled out infrastructure to 1,000 additional local exchanges reaching 1,600 buildings in July 2007.

Although “next generation access” is less advanced in the UK than elsewhere perhaps due in part to the late development of the broadband market, the first examples of FTTH investments are becoming visible as BT installs fibre in large residential developments such as Ebbsfleet Valley and has stated that it will install FTTH in all new housing developments from 2008. As consumers become used to higher access speed, we would expect the pressure on BT and other providers to provide yet higher broadband access speeds to intensify.

These three case studies illustrate the link between regulation, as measured in the ECTA Scorecard and investment. However, to understand the relationship fully, we need to look at the relationship across a wider sample than just the three largest economies and investigate other factors what may be relevant for determining levels of investment. Before reporting on our analysis of a wider set of countries, we report on previous studies by other authors on similar matters.

## 5. Literature Review

The idea that the institutional environment may have an important effect on investment, industry performance and economic growth, and that it may be potentially measured, has been highlighted over the last 10-15 years by scholars in economics and other social sciences (e.g. North, 1990). In applying these perspectives to telecommunications, Levy and Spiller (1994, 1996) surveyed the performance of regulated telecommunications industries in different political and social environments. They argued that a country's institutional endowment at the macro-political level determines the scope for arbitrary administrative discretion, the confidence of investors that their assets will not be arbitrarily appropriated and, through this, the performance of regulated industries.

The institutions that Levy and Spiller emphasized included: the existence of a strong and independent judiciary; whether governments are unified (as in parliamentary systems) or divided (as in many presidential systems); whether parties alternate in government; and the quality of the regulatory bureaucracy. In a subsequent study, Henisz and Zelner (2001) explored how political institutions, measured by an index of checks and balances, affect the long run level of penetration of telecommunications infrastructure in 147 countries during 1960-1994. Their variable indicating political constraint showed a strong and positive relationship with growth of main lines per 100 inhabitants. Their study highlights the importance of the macro-polity for promoting steady and strong incentives to private investors in a sector where opportunistic behaviour may be expected. Other systematic empirical tests of this hypothesis, including Henisz (2000, 2002), have presented similar evidence in support of the proposition that investment will flourish and industries and economies will perform better where policy stability is assured by a large number of robust checks and balances constraining opportunistic behaviour by governments (Gutierrez 2003a, b).

### 5.1 Criteria for Regulatory Governance

While the institutional structure at the macro-political level is clearly important, also important are the more micro-level institutions that bear directly on the quality of regulatory governance of individual utility industries.

Discussions of desirable institutional arrangements for effective regulation of utility industries are now numerous and include: Brown et al (2006), Melody (1997), Smith (1997a, b, c and 2000), Green (1999), Estache (2003), Kerf et al. (2001), Mustafa (2002), Smith and Wellenius (1999), Stern (1997), and Stern and Holder (1999).

The most frequent variable examined is *regulatory independence* which is often simply characterised by a dummy variable - such as whether a country has a separate regulatory agency not directly under the control of the ministry. For example, Wallsten (2002) uses a dummy for whether a country has established a separate regulatory authority and observes that this variable is "better characterized as indicating a country's propensity to undertake regulatory reforms rather than the effect of a separate regulator per se". Wallsten relies on subjective responses by regulatory authorities to the question whether they considered themselves "independent from political power."

Other studies that make use of a dummy variable include Gutierrez and Berg (2000), Fink et al. (2002) and Bauer (2005).

However, there have also been attempts at a wider measure of *regulatory quality*. Gutierrez (2003a, b) constructs a "regulatory framework" index that is an equally weighted sum of the presence of six institutional elements said to bear on good regulatory governance. The elements are:

- whether there is separation between the incumbent operator and regulatory activities.
- independence from government;
- accountability, measured by the existence of mechanisms to resolve disputes between regulators and operators;
- clarity of the regulator's roles and objectives; and
- transparency and participation in the regulatory process. (i.e. whether the creation of the regulatory body is backed by legislation rather than by executive decree.)

Gual and Trillas (2006) have constructed a more detailed index of regulatory features bearing specifically on regulatory independence from government. While focusing on the determinants of policy reforms (rather than the outcomes of regulatory reform) their work provides a useful example of measuring the multi-dimensional nature of the reform process in telecommunications. They focus on entry barriers (including the degree to which market opening or deregulation policies are asymmetric, or biased in favour or against entrants) in addition to the degree of independence (vis-à-vis their governments) of regulatory authorities. They present new indices, both for entry barriers and for independence.

Edwards and Waverman (2006) uses a Composite Regulatory Performance Indicator EURI, *CPRleuri*, which is based on the simple average of two sub-indicators that measure respectively regulatory independence (EURI-I) and regulatory quality (EURI-Q). (See Annex A for more details of both Gail and Trillas and Edwards and Waverman.)

## 5.2 Regulatory Performance and Economic Outcomes

Some authors have moved on from assessing the independence and quality of the regulatory environment to assessing the effect of regulation on economic outcomes. The main empirical papers in this area (e.g. Fink, Mattoo and Rathindran (2003), Wallsten (2002) and Gutierrez (2003)) estimate the effects of regulation on

- (a) mainline penetration rates (a standard measure of capacity) and
- (b) efficiency (e.g. mainlines per employee).

Boylaud and Nicoletti (2001) measure the effect of regulation on three measures of outcome: productivity, prices and quality.

These studies typically estimate panel data models with one or other of the outcome measures as the dependent variable, and include regulation as an independent variable along with competition and privatisation variables, as well as standard control variables.

In a study of 20 Latin American countries, Gutierrez and Berg (2000) found that their index of regulatory framework was positively associated with network deployment, which means that a better, specific regulatory environment leads to greater investment in telecommunications

Fink et al (2002) find that both privatisation and competition lead to significant improvements in performance. But a comprehensive reform programme, involving both policies and the support of an independent regulator, produced the largest gains: an 8 percent higher level of mainlines and a 21 percent higher level of productivity compared to years of partial and no reform. Interestingly, the sequence of reform matters: mainline penetration is lower if competition is introduced after privatisation, rather than at the same time. The authors also find that autonomous factors such as technological progress, have a strong influence on telecommunications performance, accounting for an increase of 5 percent a year in teledensity and 9 percent in productivity over the period 1985 to 1999.

Wallsten (2002) finds that countries that established separate regulatory authorities prior to privatisation saw increased telecom investment, fixed telephone penetration, and cellular penetration compared to countries that did not. Moreover, he finds that investors are willing to pay more for telecom firms in countries that established a regulatory authority prior to privatisation. This increased willingness to pay is consistent with the hypothesis that investors require a risk premium to invest where regulatory rules remain unclear.

Alesina et al (2005) assembled data on regulation in several sectors of many OECD countries to provide evidence that regulatory reform of product markets is associated with an increase in investment. A component of reform that plays a very important role is entry liberalisation, but privatisation also has a substantial effect on investment. They use a measure to capture the “intensity of regulation”, using data collected by Nicoletti et al. (2001), (who extended the cross-sectional data

contained in the OECD International Regulation Database) and described in detail by Nicoletti and Scarpetta (2003).

Boylaud and Nicoletti (2001) examine the relationship between regulation, market structure and performance, specifically in the telecommunications sector. They focus on three measures of economic performance: labour productivity, prices and quality across three services: international, long distance (trunk) and mobile. Their regression model estimates for each service and for all services pooled using panel data techniques.

They find that competition, and the mere prospect of liberalisation, brings about productivity and quality improvements and reduces prices. Prospective liberalisation prompts significant adjustments by the incumbent. Boylaud and Nicoletti say that their results confirm that the economic benefits of liberalisation and economic reform are large and relatively quick to come about.

Of specific relevance to this paper is a study by London Economics (LE) and Price Waterhouse Coopers (PWC) conducted for the European Commission in 2006 (London Economics 2006) which specifically examined the relationship between investment, at both firm and national level, and regulation. The LE study gathered data on investment levels at the firm level using both published annual accounts and a primary research survey by PWC and identified primary and secondary drivers of investment (Figure 3).

**Figure 9: Analysis of Investment Drivers**

<b>Primary Drivers</b>	Level of expected return		
	Risk and uncertainty associated with expected returns		
<b>Secondary Drivers</b>	<b>Economy-wide</b>	<b>Industry-specific</b>	<b>Company-specific</b>
	GDP per capita	Regulation by NRA	Cost of capital
	Demographic/geographic characteristics	Competition	Credit rating & debt levels
	Economic cycle (financial bubble)	Technological Progress	Take-overs and mergers
	General regulation (not sector specific)	Demand for e-communications services	Company performance

Source: London Economics 2006

Using investment as the dependent variable they produced regression models with the following form:

$$\ln(I_{ijt}) = \alpha + \beta Z1_{jt} + \delta Z2_{jt} + \eta Z3_{ijt} + \varepsilon_{ijt}$$

Where  $I$  = investment,  $Z1$  = country specific characteristics that change over time,  $Z2$  = industry specific characteristics and  $Z3$  = firm specific characteristics.

LE's models show that regulation, measured by the OECD is positively correlated with investment with significance at 5% and when the ECTA Scorecard is used as an alternative measure in their country level model, it is also significant, though only at 7%.

## **6. Econometric Analysis: Data, Models, Results**

### **6.1 Hypothesis**

Our hypothesis is that regulation which promotes competition is associated with higher levels of investment in the telecommunications industry. As stated at the beginning of Section 2, we have chosen investment as the outcome because it is a specific requirement of the NRF that NRAs promote efficient investment and may be thought to lead to other market outcomes such as choice and quality. It is also measurable and comparable across countries. Prices, are both harder to compare across countries and may any way be directly affected by regulators setting the price at wholesale and/or retail level.

Early version of the ECTA Scorecard have sought to test this hypothesis and found a strong and positive correlation between regulation, as measured by the Scorecard, and investment levels reported by the OECD (Beaufort, Jones Day 2002, ECTA, Jones Day, SPC Network 2004, 2005). However, these earlier studies were restricted by the temporal misalignment of regulatory and investment data: investment data were for a period two years before the Scorecard. We were always aware that this difference in the timing of the data potentially weakened the results of the analysis. However as we found reasonable consistency of the investment data over time we were content to use an earlier year as a proxy for a later year and because markets are often adept at anticipating regulation (rational expectations).

Another weakness of earlier analyses was that they were open to the accusation that the Scorecard results had been affected by a desire to fit them to the investment data which was available at the time the Scorecard was produced.

No such problems exist for this study. We have produced models using data for both regulatory scores and investment data for the same year (2003 and 2005) and lagged model using investment data for 2005 with regulatory scores for 2003. The time lag included in this paper therefore is in a more reasonable direction and shows the response, if any, to regulation two years prior to investment. There was also no possibility of manipulating the Scorecard or RRI results to fit the investment data, as both were completed and published before 2005 investment data became available, in July 2007.

### **6.2 Data**

Investment is measured for 2003 and 2005. Our source for investment data is the OECD and in particular OECD Communications Outlook which is published biannually (OECD 2007). Investment is presented in 2005 US dollars.

Investment is defined as reported capital expenditure by all operators, excluding licence fees. The OECD provides no further breakdown of investment, i.e. whether in fixed or mobile networks and whether in tangible or intangible assets. Using total investment, rather than data for a particular sub-section of the market, is appropriate as both the ECTA Scorecard and the RRI also measure regulation in the telecommunications market as a whole.

We have used two indices of regulation to measure regulatory effectiveness: the ECTA Scorecard for both 2003 and 2005 and the OECD's Regulatory Reform Index (RRI), the most recent version of which covers 2003. As described in Section 3, the ECTA Scorecard measures sector regulation across a wide range of indicators covering the powers and efficiency of the sector regulator, the powers and efficiency of the dispute settlement body, general access conditions and specific product sectors. The RRI measures indicators of product market regulation in non-manufacturing sectors of the economy. We have extracted the scores for telecommunications only.

The Scorecard results and investment levels reported by the OECD are shown in Figure 10.

**Figure 10: Scorecard Results and Investment 2003, 2005**

	Scorecard		OECD	Investment (\$m)	
	2003	2005	2003	2003	2005
Austria		339	1.6		509
Belgium	214	281	2.1	1,006	1,187
Czech Republic		244	N/a		538
Denmark	308	398	0.7	955	1,137
France	255	349	2.1	6,784	7,840
Germany	203	220	1.6	7,037	8,162
Greece		218	1.7		813
Hungary		286	1.3*		768
Ireland	317	327	1.5	639	684
Italy	290	311	1.0	8,746	8,609
Netherlands	256	296	1.1	1,930	1,340
Poland		230	1.6*		1,539
Portugal		300	1.5		911
Spain	256	291	1.2	5,760	5,797
Sweden	276	311	1.8	1,577	1,182
UK	379	440	0.5	11,963	13,205

\* 2002, latest score available

### 6.3 Correlations

The first test of our hypothesis is a set of simple correlations between the level of investment and the Scorecard results for each country. We have produced both value (Pearson) and rank (Spearman) correlations for the Scorecard normalising investment by both population and Gross Domestic Product (GDP).

The correlation results are shown in Figure 11 below. Rows 1 and 2 correlate the OECD investment data for 2003 with both the Scorecard and the RRI measure of regulation for the same year. Rows 3 and 4 correlate the investment data for 2005 with the regulation data for 2003. Row five correlates the investment data with the ECTA Scorecard for 2005. The OECD regulation data are not available after 2003.

**Figure 11: Correlation Results**

Row	Sample	Investment Year	Regulation Source	Regulation Year	Values		Ranks	
					Investment per capita	Investment as % of GDP	Investment per capita	Investment as % of GDP
1	10	2003	ECTA	2003	0.906	0.794	0.879	0.794
2	10	2003	OECD	2003	-0.655	-0.646	-0.632	-0.626
3	10	2005	ECTA	2003	0.826	0.735	0.842	0.721
4	10	2005	OECD	2003	-0.629	-0.650	-0.620	-0.650
5	16	2005	ECTA	2005	0.794	0.698	0.665	0.521

In all cases the correlation coefficients are more than 0.5 and in all but one case, greater than 0.6 and in the expected direction. The coefficients on OECD are negative as the OECD assigns a low score to the better performing countries.

The relationship between Scorecard and Investment per Capita in 2003 and between the Scorecard and investment as a percentage of GDP, respectively the strongest and the weakest of the correlations, are shown in Figures 12 and 13 below.

Figure 12: Relationship between Scorecard and Investment 2003

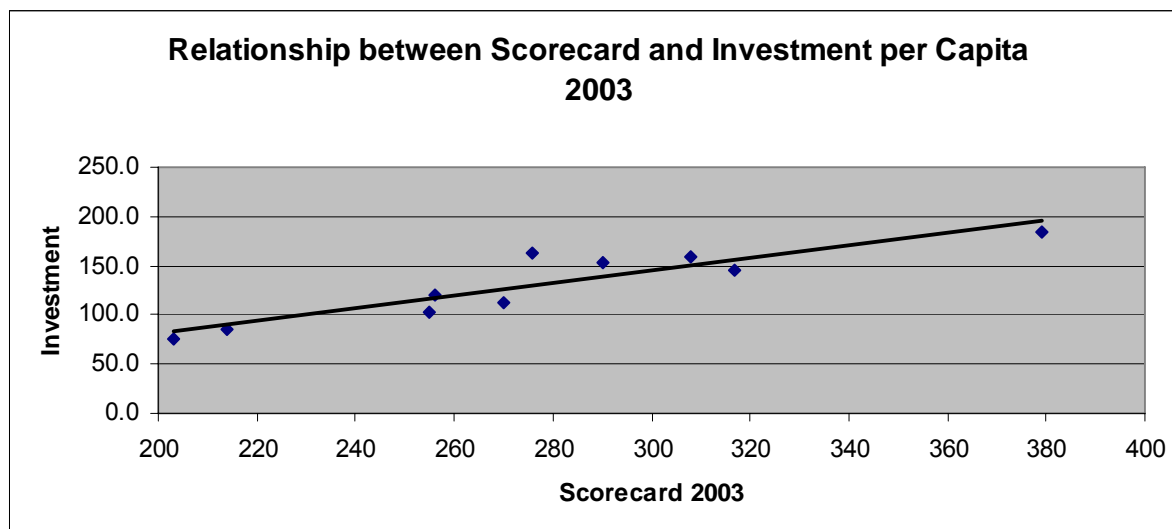
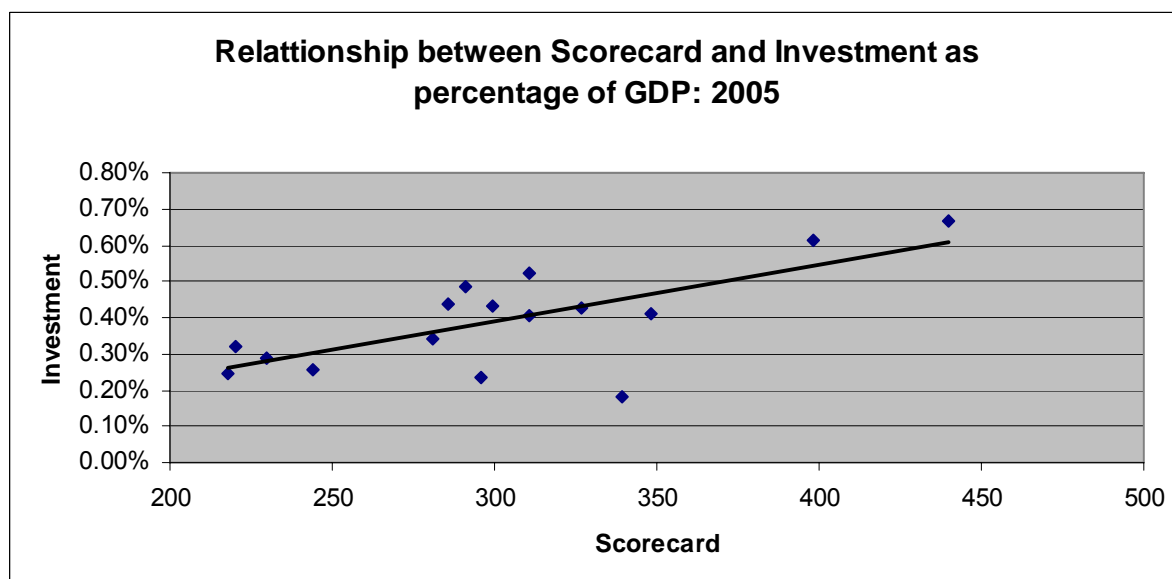


Figure 13: : Relationship between Scorecard and Investment 2005



To test the robustness of the correlations we have removed the two extremes from the Scorecard and RRI for each year. The results are shown in Figure 14 and follow the same structure as Figure 11. We have not reported the rank correlations for the OECD as two of the outlier countries (France and Belgium) received equal scores. Excluding three countries from the correlation would have resulted in a sample too small to be of value.

Figure 14: Correlation Results Excluding Extremes

Row	Sample	Investment Year	Regulation Source	Regulation Year	Values		Ranks	
					Investment per capita	Investment as % of GDP	Investment per capita	Investment as % of GDP
1	8	2003	ECTA	2003	0.856	0.644	0.762	0.595
2	8	2003	OECD	2003	-0.386	-0.377		
3	8	2005	ECTA	2003	0.712	0.516	0.786	0.548
4	8	2005	OECD	2003	-0.405	-0.430		
5	14	2005	ECTA	2005	0.693	0.504	0.574	0.367



As can be seen from the Figure 14, the correlation coefficients once the outliers are removed are somewhat weaker, as would be expected given the small samples, but remain above 0.5 for all the value correlations using ECTA and all but one of the rank correlations. Using the OECD RRI, the correlations fall below 0.5 once the outliers are removed.

#### 6.4 Econometric Models

The correlations show a clear relationship between investment and regulation. However, regulation is not the only factor that determines the level of investment. As discussed in the literature review, London Economics (2006) identified both Primary and Secondary drivers (see above).

Other writers have also found multiple drivers of investment. For example, Röller and Waverman (2001) found that the geographic area of a country is very significant in explaining the level of investment: larger countries tend to invest more. London Economics find that GDP per capita, land area and population density are all positively correlated with investment. Our own study in of entrants' investment criteria (SPC Network 2004) found that the location of customers and the size of the economy were important. At the industry specific level, London Economics find that regulation by the NRA is significantly correlated with investment.

In our models we have normalised the dollar value of investment by population (following Li and Xu 2002) to account for economy size<sup>9</sup>. Our model is limited by the number of countries covered by the ECTA Scorecard in both 2003 and 2005. We have therefore been constrained on the number of independent variables included in the model by the degrees of freedom as well as data availability.

We have included the following independent variables:

- |                           |  |
|---------------------------|--|
| <i>GDP per Capita</i>     | It may be expected that countries with a higher per capita income invest more in telecommunications as firms may expect a higher return on their investments. On the other hand, less wealthy per capita countries may experience faster growth and so per capita investments will be higher. Given that all the sample countries are high income, European states, we expect a positive relationship with investment. |
| <i>Geographic Area</i>    | The level of investment may be affected by geographic size: larger countries need to invest more in transmission infrastructure to reach all members of the population. If such a relationship exists, we expect it to be positive, as found by Röller and Waverman.   |
| <i>Sector Regulation</i>  | This is our primary variable of interest to test our hypothesis that sector regulation is a driver of investment. We use both the ECTA Scorecard results and the OECD Regulatory Reform Index as measures of sector regulation. These two measures of regulation are entirely independent of each other. We expect a positive relationship with the ECTA Scorecard and negative relationship with RRI.                 |
| <i>Real Interest Rate</i> | We have taken the real interest rate (defined as the long term interest rate less the consumer price index) as a proxy for the cost of capital. We do not know the Weighted Average Cost of Capital (WACC) for each firm. We expect a negative relationship: as interest rates rise, so investment will decline.   |

All data other than investment, the Scorecard and the RRI are taken from the OECD statistical database available at [stats.oecd.org](http://stats.oecd.org).

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<sup>9</sup> We also developed models using Investment as a percentage of GDP as the dependent variable. However, having GDP as a denominator on one side of the equation and numerator on the other produced some odd results. The coefficients on all variables, except GDP per capita, were exactly the same as when investment per capita was the dependent variable and the coefficient on GDP per capita was exactly 1.0 higher. All test statistics were the same. These models therefore did not contribute to our understanding of the relationship between investment and regulation and so have not been reported.

To test the hypothesis we have developed cross-sectional, lagged and pooled time-series/cross section model which take the general form:

Investment per capita = f(GDP per capital, Geographic Area, Regulation, Real Interest Rates)

Models 1, 2 and 3 are cross sectional models and take the form.

$$\text{Log}\left(\frac{\text{INV}_i}{\text{POP}_i}\right) = \alpha + \beta \log\left(\frac{\text{GDP}_i}{\text{POP}_i}\right) + \chi \text{GA}_i + \delta \log \text{SC}_i [\text{RRI}_i] + \phi(\text{IR}_i - \text{CPI}_i) + \varepsilon$$

Model 1 is a cross-sectional model for 2005 and uses the Scorecard as the measure of regulation. Model 2 is a cross-sectional model for 2003 and uses the Scorecard as the measure of regulation and Model 3 is also a cross-sectional model for 2003 but uses the RRI as the measure of regulation.

Models 4 and 5 are lagged models, using the measure of regulation two years before the measure of investment and take the form:

$$\text{Log}\left(\frac{\text{INV}_i}{\text{POP}_i}\right) = \alpha + \beta \log\left(\frac{\text{GDP}_i}{\text{POP}_i}\right) + \chi \text{GA}_i + \delta \log \text{SC}_{i,-2} [\text{RRI}_{i,-2}] + \phi(\text{IR}_i - \text{CPI}_i) + \varepsilon$$

Where:

INV = investment  
 GDP = Gross Domestic Product  
 POP = Population  
 GA = Geographic Area (square miles)  
 SC = ECTA Scorecard  
 RRI = OECD Regulatory Reform Index  
 IR = Mean long term interest rate  
 CPI = Consumer Price Index  
*i* = Country *i*

The results of Models 1 – 5 are tabulated below. t-stats are reported in brackets beneath the coefficient.

Model	1	2	3	4	5
Dependent Variable	Log INV_05/ POP_05	Log INV_03/ POP_03	Log INV_03/ POP_03	Log INV_05/ POP_05	Log INV_05/ POP_05
Constant	-8.28 (3.55)	-13.56 (-4.29)	0.87 (0.84)	-10.05 (-5.68)	0.99 (0.83)
Log GDP per Capita 2005 <i>Log(GDP_05/POP_05)</i>	0.53 (2.16)**			-0.10 (-0.35)	0.89 (2.70)**
Log GDP per Capita 2003 <i>Log(GDP_03/POP_03)</i>		-0.59 (-0.84)	0.81 (2.58)**		
Geographic Area (GA)	1.78E-06 (1.70)	1.14E-07 (-0.11)	1.96E-06 (1.82)	5.60E-07 (0.38)	1.91E-06 (1.65)
Log Scorecard 2005 <i>Log(SC_05)</i>	1.38 (4.09)**				
Log Scorecard 2003 <i>Log(SC_03)</i>		1.67 (4.48)***		1.38 (5.11)***	
Log OECD Reg Reform 2003 <i>Log(OECDRR_03)</i>			-0.50 (-3.78)***		-0.59 (-3.61)***
Real Interest Rate 2005 <i>(IR_05-CPI_05)</i>	-0.09 (-2.08)*			-0.10 (-1.14)	-0.03 (-0.39)
Real Interest Rate 2003 <i>(IR_03-CPI_03)</i>		0.04 (0.62)	-0.13 (-1.74)		
Adjusted R <sup>2</sup>	0.62	0.78	0.67	0.43	0.53
Sample (n)	16	10	10	10	10

\*\* Significant at 5%., \*\*\* Significant at 1%

The third type of model we have produced is a pooled time-series/cross-section model using data from the ten countries in the 2003 Scorecard for both 2003 and 2005. Our original expectation was that a fixed effects model would be most appropriate (as for example Li and Xu 2002). However, using a Wald coefficient test we found that there was no significant (at 5%) difference between the intercepts for each country and so the constant was constrained to be common across all countries. This maybe because the countries are all relatively similar western European economies or that the country specific effects are captured in the variables in the model. We also found that having no cross-section weighting produced more realistic models<sup>10</sup>. As the geographic area does not change over time, and anyway was insignificant as a variable, it has been omitted from these pooled models.

This model takes the form:

$$\text{Log} \left( \frac{INV_{i,t}}{POP_{i,t}} \right) = \alpha + \beta \log \left( \frac{GDP_{i,t}}{POP_{i,t}} \right) + \chi GA_{i,t} + \delta \log SC_{i,t} + \phi (IR_{i,t} - CPI_{i,t}) + \varepsilon$$

We were unable to produce a pooled model using the RRI due to the lack of available data for 2005.

Model	6
Dependent Variable	INV/POP (Common Effects)
Constant	-11.72 (5.13)
Log GDP per Capita <i>Log(GDP/POP)</i>	-0.56 (-1.33)
Log Scorecard <i>Log(SC)</i>	1.37 (5.88)***
Real Interest Rate (IR-CPI)	-0.01 (-0.15)
Adjusted R <sup>2</sup>	0.67
Durbin-Watson	1.6
Sample (n)	10

\*\*\* Significant at 1%

## 6.5 Comments on Results

GDP per capita is significant at 5% and positively related to investment in models 1, 3 and 5. In the other models it not significant. This is a somewhat more ambiguous result than we would expect based on LE (2006) but nevertheless indicates that wealthier per capita countries tend to invest more per capita.

The geographic area of a country is found to be not significant in affecting change in the level of investment. This is contrary to the findings of London Economics and Röller and Waverman.

Regulation, which is our primary variable of interest, is found to be significant at 1% in all models. As expected, when the Scorecard is used to measure regulation the relationship is positive and when the OECD Regulatory Reform Index is used, the relationship is negative. The models where the Scorecard is used produce a stronger coefficient (between 1.37 and 1.67) than when the OECD RRI used (-0.50 and -0.59). The strength of the coefficient and the degree of significance are not affected by the specification of the model which suggests a robust finding.

Real interest rates are weakly and negatively correlated at 10% significance in one model and not significant in all others.

The Adjusted R<sup>2</sup> measures the goodness of fit of the regression: the closer to 1.0 the better the fit. In most cases this is good (greater than 0.5) though in model 4 the R<sup>2</sup> is lower at 0.43. Four of the six models have a strong R<sup>2</sup> above 0.6. In the pooled model, the Durbin-Watson statistic indicates that is

<sup>10</sup> Including cross section weights produced unrealistically high R<sup>2</sup> of more than 0.99.

some problem with autocorrelation, though with only two time periods we do not regard this as of significant concern.

Perhaps the most important finding is that in all models and using two independently produced measures, regulation is found to have a significant relationship with investment. The two lagged models suggest that there is some degree of cause and effect in that countries with better regulation in 2003 tended to invest more per capita in 2005.

Of course, not all models are perfect and our models here work with very small data sets. The size of the sample is constrained by the number of countries surveyed in the 2003 ECTA Scorecard. However, with each iteration of the Scorecard more countries have been added, so in the future we expect to be able to report on a larger sample of countries in the cross-sectional models.

## 7. Conclusions and Recommendations for Policy Makers

This paper has reviewed the literature on both regulatory structures and the impact of regulation of economic outcomes. Previous literature has shown there to be a potentially important relationship between the institutional and regulatory environment and industry performance. In this paper, we have also developed models showing the relationship between effective, pro-competition regulation and levels of investment in telecommunications. Our overall finding is that there is a strong and positive relationship between effective regulation and investment. Whilst other studies have identified regulation as one of many factors affecting investment levels, we find that it has the strongest effect on investment, after normalising for population and GDP.

Using the ECTA Scorecard the size of the coefficient on regulation is consistent across all our models at around 1.4. If this coefficient was regarded as a measure of elasticity, it would suggest that, *ceteris parabis*, a 1% increase in regulatory effectiveness, as measured by the Scorecard, would result in a 1.4% increase in investment. When the OECD RRI is used as the measure of regulation the coefficient is lower at between 0.50 and 0.59, indicating that a 1% increase in regulatory reform, as measured by the RRI, would lead an increase in investment of between 0.50 and 0.59%

The message for policy makers is that effective implementation of the NRF to encourage competition helps to achieve one of the policy goals set out in Article 8.2 of the Framework Directive: encouraging investment. In line with current thinking, this means implementing policies that remove barriers to entry, empower consumers and prevent discrimination by owners of bottleneck assets.

There has been much talk, particularly in Germany, about the granting of de facto monopolies to promote the development of Next Generation Access (NGA). Our brief case studies of France and Germany show how encouragement of competitive development of NGA, albeit initially in urban areas, is more effective. The proposed regulatory holiday in Germany would introduce barriers to entry in high speed broadband, remove power from consumers and allow discrimination by the owner of the bottleneck VDSL asset.

The evidence from this study suggests that Armstrong and Sappington (2006) are correct that policies which establish even temporary monopolies, which may be well meant, are not recommended if investment is to be encouraged.

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## Annex A

### Regulatory Metrics (Gaul and Trillas, 2006)

Indices of asymmetric deregulation policies aggregate information on the following measures or indicators:

- The degree to which entry in the industry is subject to investment conditions of any kind.
- The average of the number of mobile providers in 1996 and 1997.
- The method of spectrum allocation.
- The existence of number portability in fixed and mobile telephony (two variables).
- The existence of carrier selection and carrier pre-selection in local, long distance and international telephony (six variables).
- The availability of local loop unbundling.

The indices of regulatory independence are based on information which covers the following indicators:

- The degree to which the regulatory agency is competent in the following policies: licensing, interconnection, tariffs, scarce resources allocation (such as spectrum frequencies and numeration plans), and universal service (five variables).
- The degree to which its funding sources are independent of the government's discretion.
- The rules of appointment of the head of the agency or its board.
- The length of the term in office for the head of the office or the members of the board.
- The rules about obligations to report to the government, parliament or another official body.
- The years since the establishment of the agency's effective operation.
- The percentage of private ownership of the incumbent.

### EURI Components (Edwards and Waverman, 2006)

The EURI components take into account whether:

- i) the NRA is single or multi-sector (multi-sector);
- ii) the NRA is single or multi-member (multi-member);
- iii) the NRA is funded by government appropriations or industry fees and consumer levies (funding);
- iv) the NRA reports only to the executive government or also to the legislature (reporting);
- v) the NRA has adequate powers regarding interconnection issues (interconnect powers);
- vi) the NRA shares its regulatory functions with the executive (shared roles);
- vii) the legislature is involved in NRA member appointments (legislative appointment);
- viii) NRA member terms of appointment are fixed (fixed terms);
- ix) NRA member terms are renewable (renewable terms);
- x) NRA resources are adequate (staff and budget); and
- xi) the NRA has been in operation for at least two years (experience).

Each element is measured as either a categorical or dummy variable on a zero to one scale

The EURI Regulatory Quality (EURI-Q) index is the sum of five elements identifying on overall regulatory quality (aside from independence):

- i) clarity of roles (s),
- ii) NRA powers index (zero to one),
- iii) enforcement powers (s),
- iv) effective appeals(s) and
- v) effective licensing (s).