# Only a few roads lead to Rome:

# The regulation of entry and broadband performance

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## BIOGRAPHY

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## ABSTRACT

The relationship between competition and broadband performance is complex. Previously, authors have suggested that medium regulation of entry would be the most important tool to promote investment and innovation (Aghion et alii 2005; Katz 2007 and 2008); however, previous empirical data has shown that medium entry regulations do not lead countries to the same broadband performance across all nations. This paper examines the interactions between regulatory variables with social, demographic and educational factors. The main goal is to look into the different ways countries can achieve similar broadband performance and uses Qualitative Comparative Analysis (QCA) to examine 27 European countries from 1997 to 2008.

## Keywords

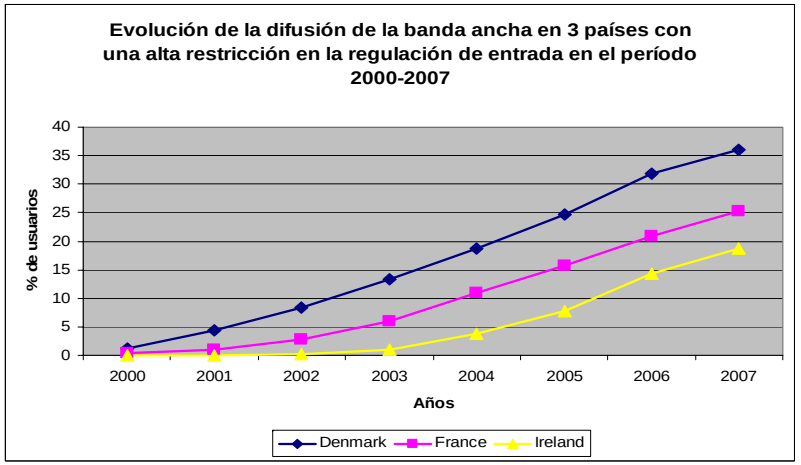
Entry Regulation, broadband performance; qualitative comparative analysis

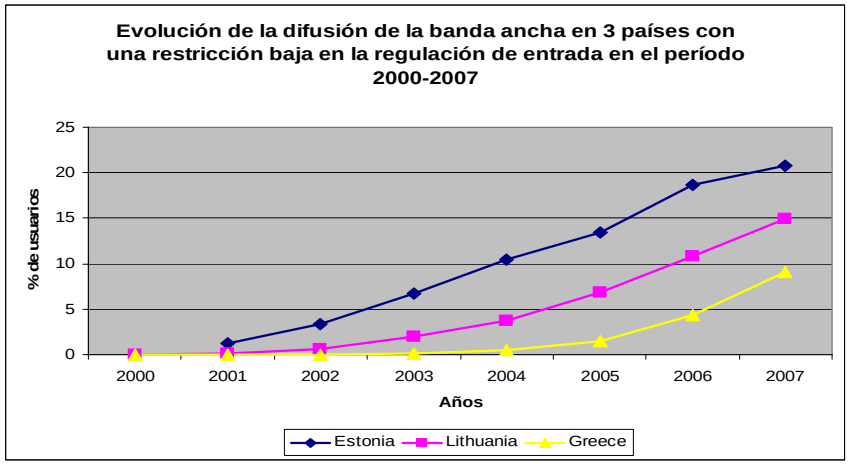
## INTRODUCTION

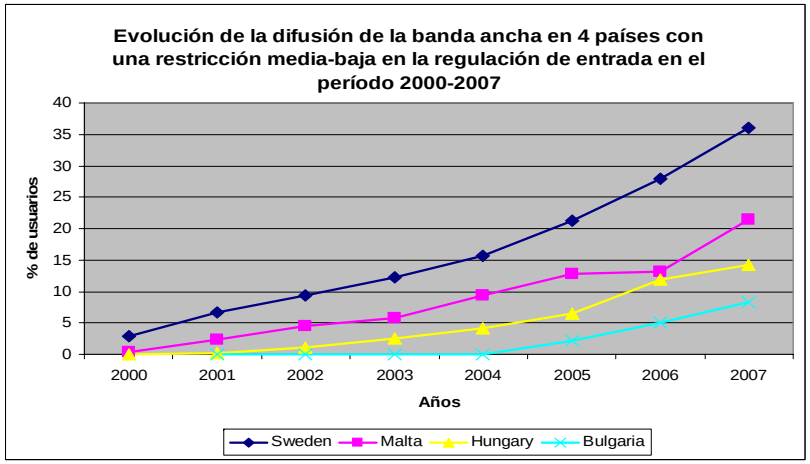
The institutionalism framework emphasizes the importance of rules and institutions for economic performance (North 1990). In the telecom sector, the regulatory framework serves to encourage both investment and the diffusion of technology (Friederiszick; Grajek and Röller 2007, Katz 2007 and 2008). One of the arguments most commonly used to explain the differing performance in broadband penetration is the existing regulatory framework (Katz 2007 and 2008); however, studies have shown that the relationship between competition and Internet penetration is not quite as obvious as it seems. The mechanisms involved in this relationship are much more complex than previously thought (Guillén and Suárez 2001; Katz 2008; Aghion et alii 2005). Research has shown that greater competition does not, in all cases, lead to higher investment and broadband diffusion (Katz 2007 and 2008).

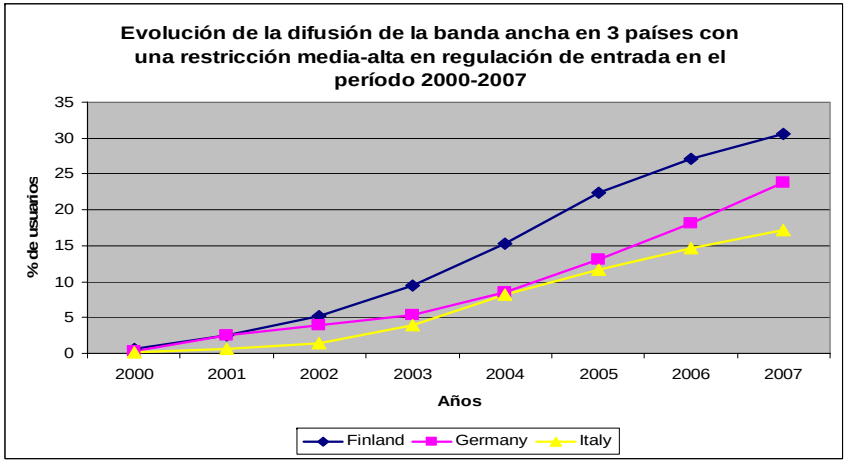
By examining the relationship between entry regulation and broadband penetration, it seems as though countries with the same regulatory framework often have different broadband performance. For example, several countries with high entry regulation, therefore fewer companies competing, have mixed results with respect to broadband penetration. Denmark has high broadband penetration, France has medium penetration, and Ireland has low penetration. The same results are found for countries with a medium-high entry regulation: high penetration for Estonia, medium for Lithuania, and low in Greece. Again, the same is true for countries with a medium-low entry regulation: high penetration is found in Sweden, medium in Hungary and Malta, and low in Bulgaria. Finally, countries with low entry regulation and, in theory, the highest number of companies operating have high penetration in Finland, medium in Germany and low in Italy. These results simply point to fact that, while regulation may be as important as stated in much of the literature, the relationship between competition and broadband penetration is more complex than assumed (Katz 2008; Aghion et alii 2005).

Table 1. Evolution of broadband penetration in countries under different market entry regulation (2000-2007)




Source: Own framework

The fundamental research question here is: under what social and demographic conditions does market entry regulation promote differences in broadband performance?

The main contributions of this research can be seen as the following: first, we analyze the interaction between regulation and social and demographic factors. In this sense, the research is in line with recent studies, which indicate that the impact of regulation was tempered by a country's social and demographic variables (Flamm 2007; Ford, Koutsky and Spiwak 2008). Second, it analyzes more concrete and precise variables, such as secondary education. Finally, it analyzes the public policy impact on a regulated sector such as telecommunications. As some scholars have pointed to the benefits of regulation, there are still few empirical studies on the effects of these policies in Europe (Majone 1994, Sun and Pelkmans 1995). This is all the more important given the fact that it is in Europe where liberalization and privatization processes have been most intense (Noam 1992).

## 1. THEORETICAL FRAMEWORK

### 1.1 The spread of broadband

To explain the broadband performance differences authors have pointed out the following factors:

*a) Economic factors*

Both macro and micro economic factors are relevant to explain differences in broadband adoption. Some studies have shown that countries with greater wealth, measured by income per capita, also have higher penetration (Hargittai 1999, Kelly and Petrazzini 1997). According to the OECD, there is a correlation of 0.65 between income per capita and the adoption of broadband in its member countries (OECD 2009).

*b) Political and institutional factors*

The policy variable that has been most often used to explain differences in the level of broadband penetration is the level of competition. Some authors have suggested that the relationship between greater competition and increased broadband penetration is not as obvious as previously thought (Guillén and Suárez 2001). The economic theory of regulation has shown that there is a trade-off between competition, investment and innovation (Aghion et alii 2005; Katz 2007 and 2008). In this sense, the relationship between competition and investment and innovation seems to follow the shape of an inverted U (Aghion et al, 2005). Based on this model there is a peak of competence under or above this point for investment and innovation down. The causes are the existence of a monopoly or a massive competition.

In the case of broadband, empirical studies have made a distinction between two models of competition based on the number of players in the market: competition based on services and infrastructure-based competition. Applying the theory described previously, competition based on service means the existence of low barriers to entry with a large number of market players. By contrast, competition based on infrastructure means that the industry is more concentrated in a small number of actors with higher barriers to entry. The creation of a network or platform requires high investments (Kittl, Lundborg and Ruhl 2006; Katz 2007 and 2008, Friederiszick; Grajek and Röller 2007). Empirical evidence has indicated that infrastructure-based competition stimulates greater levels of both investment and innovation, relative to competition based on services (Friederiszick; Grajek and Röller 2007, Katz 2007; DiStaso, Lupi and Manenti 2006).

To measure the effects of the environment, which create differences in the markets, some authors have introduced political variables. (Henisz and Zelner 2001; Roller et alii 2007). Henisz and Zelner have analyzed the effect of political risk, understood to be the discretion of the executive changes to rules on investment in telecommunications (Henisz and Zelner 2001). Röller, in studying the effects of regulation on investment and innovation, introduces the attitude of governments towards their own regulation and towards the European integration process arising from the regulation and found a significant relationship (Friederiszick; Grajek and Röller 2007). In these cases, it is assumed that broadband markets are not homogeneous and that socio-demographic factors can play a very crucial role (Dwivedi, Papazafeiropoulou and Choudrie 2008).

*c) Technological Factors*

Technological factors, such as the existence of a telecommunications infrastructure, can be proxied by the number of telephone lines (Hargittai 1999, Ford, Koutsky and Spiwak 2008) and the number of computers (Aron and Burnstein 2003). These measures, however, ignore one aspect that may be relevant to consider, namely the network effects that occur when one adoption can encourage others to do the same.

*d) Social and demographic factors*

Studies have shown that there are a number of geographical patterns in broadband adoption with urban areas generally more likely to adopt broadband than rural areas (Prieger 2003). At the micro-social level, the profile of adopters in this case is the same as the profile of adopters of other innovations (Rogers 2003). Namely, they are typically men, with higher income and greater exposure to English (Rappoport et alii 2003; Hargittai 1999).

## 2. THE CAUSAL MODEL

The dependent variable is the total broadband performance at the end of the period. Broadband performance, in this analysis, will be the difference between broadband penetration in t+n and broadband penetration in t0 divided by n. Specifically, this variable has three categories: 1) High broadband performance, 2) Medium broadband performance, and 3) Low broadband performance. Each of these three categories will be operationalized as a dummy variable. The first variable, countries with "high broadband performance", will take 1 for observations "whose total broadband performance value is higher than the first quartile value" and will take 0 for "Otherwise". The second category, countries with "medium broadband performance", will take the value 1 for observations "whose total broadband performance value is between the first and third quartile values" and take 0 for "Otherwise". The third variable, countries with "low broadband performance", will take 1 for observations "whose total broadband performance value is lower than the third quartile value" and take 0 for "Otherwise".

The main independent variable in our analysis is entry regulation, which refers to the requirements that are set by national regulatory authorities and must be met by companies interested in entering the market. In our analysis, entry regulation is measured directly from the decisions of regulatory authorities, but it is important to note that one must distinguish between the decision (input) and the result (output) (Zenhäusern; Telser; Vaterlaus and Mahler 2007). The entry regulation variable can be separated into three categories: 1) high entry regulation, 2) medium entry regulation, and 3) low entry regulation. Each category is again operationalized as a dummy variable and, for all the observations, the average entry regulation index will be ranked from highest to lowest. For the first category, "high entry regulation", the values will be: 1 for observations "whose entry regulation average value is higher than the first quartile values" and 0 for "otherwise". For the second category, "medium entry regulation", the values are: 1 for observations "whose entry regulation average value is between the first and third quartile values" and 0 for "otherwise". Finally, for the last category "low entry regulation", the values are: 1 for observations "whose entry regulation value is lower than the third quartile value" and 0 for "otherwise".

The other independent variables considered in this analysis are secondary education dropout rates, population age, wealth and density. To study secondary school dropout rates, we use the "early school leavers proportion between the population between 18-24 years old" (Eurostat 2009). To study the young population we use the "proportion of the population between the ages 0 and 24 years old". To study countries wealth we use GDP per capita and to study density the proportion of inhabitants per square meter. All the variables will be categorized according to the two main variables described.

## 3. METHODOLOGY

### 3.1 Hypothesis

The set of hypotheses are:

H1. High entry regulation in countries with high levels of wealth, density, young population and high secondary studies proportion, will lead to medium broadband performance. Under high entry regulation, the number of companies competing in the market will be reduced. The investment and innovation made by firms will be low given the lack of rivalry. The telecommunications companies will offer their broadband services for a high price because of the lack of alternatives for consumers (Aghion et al. 2005; Katz 2008). However, the existence of desirable population conditions will increase the broadband demand. Overall, the broadband performance will be medium.

H2. Medium entry regulation in countries with high levels of wealth, density, young population and high secondary studies proportion will lead to a high broadband performance. Under medium entry regulation, new firms are able to enter into the market and there are subsequent increases in competition and investment. Moreover, companies try to evade this new competition through innovation. Thus, the strategy chosen by firms under new competitive conditions consists of creating new services and products to differentiate themselves – the more innovative a company, the more users they will have. This phenomenon is known in the literature as the "escape effect" (Aghion 2005, Katz 2008). In this context, users can benefit from more competitive services in terms of both price and quality; thereby, also, taking into account the desirable demographic conditions, broadband performance will be all the higher.

H3. Low entry regulation in countries with high levels of wealth, density, young population and high secondary studies proportion, will lead to medium broadband performance. Under low entry regulation, there will be more firms in the market; however innovation and investment will be reduced. The market will be crowded and the returns for companies will be lower in relation to H1. This effect has been called the "Schumpeterian effect" in the economic literature (Aghion et al. 2005). In this situation, firms chose to compete through prices rather than innovate. Furthermore, the ratio of exit to entry of firms would be high (Katz 2007). In this situation, the quality of services and products will be lower than the situation described in H1; however, the poor quality of the services under desirable social, demographic and economic conditions can improve the broadband demand. In this situation, broadband performance would be medium.

H4. High entry regulation in countries with medium and low levels of wealth, density, young population and medium and low secondary studies proportion, will lead to a low broadband performance. The competitive scenario is very close to the situation described in H1. However, the population conditions are less favourable in terms of broadband demand. Under this situation, the broadband performance will tend to be low.

H5. Medium entry regulation in countries with medium and low levels of wealth, density, young population and low and medium secondary studies proportion, will lead to medium broadband performance. In this situation, the firms will operate in the market using the "escape effect" mechanism to compete with their rivals. However, investment and innovation will be lower than in the H2 scenario, because the population conditions are worse. In this context, products and innovation will be better than in the scenario described in H4 and H6 but not enough to achieve high broadband performance such as in H2.

H6. Low entry regulation in countries with low and medium levels of wealth, density, young population and medium and low secondary studies proportion, will lead to low broadband performance. The competitive situation is similar to the scenario described in H3. However, it is less favourable in terms of broadband demand. The broadband demand will be lower than in H3 because the population conditions are worse. In this case, the broadband performance will be low.

### 3.2 The method

Qualitative Comparative Analysis (QCA) is a new technique that allows scholars studying macrosocial phenomena using Boolean algebra. The main advantage of this new technique is that it allows combining the intensity derived typically from qualitative methods with a larger number of observations that normally is used in quantitative methods.

The application of Boolean methods to comparison gives a combination of causal and outcome conditions. These combinations are compared with each other in each round and get simpler following a process of paired comparison. The original data matrix is represented as a "truth table" that allows making multiple comparisons of configurations through computer algorithms. The final goal is to represent the different combinations of conditions that can produce a specific outcome.

### 3.3 Data

To do this analysis, the data was derived from different sources like OECD and ITU (Internet broadband penetration), Plaut Economics (regulatory variable) and Eurostat (education, GDP, population and population density).

### 3.4 Case selection

The cases selected for this study are the 27 member countries of the European Union and cases were selected according to the availability of existing data (Zenhäusern, Telser and Mahler 2007 from Plaut Economics); Eurostat 2009). Additionally, selected countries share the same regulatory framework, which emanates from the common European Union legislation. The period of analysis is from 1996 to 2008.

## 4. DATA ANALYSIS

### 4.1 Data Analysis for High Broadband Performance countries

#### *4.1.1 Truth Table*

| | X2 | X5 | X7 | X14 | Y1 | N |
|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| 2 | 0 | 1 | 0 | 1 | 0 | 3 |
| 3 | 0 | 0 | 0 | 0 | 0 | 2 |
| 4 | 0 | 1 | 0 | 0 | 0 | 4 |
| 5 | 1 | 0 | 0 | 1 | 0 | 5 |
| **6** | **0** | **1** | **1** | **1** | **1** | 1 |
| **7** | **1** | **0** | **0** | **1** | **1** | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 8 | 1 | 1 | 0 | 0 | 0 | 1 |
| 9 | 1 | 1 | 0 | 1 | 0 | 1 |
| 10 | 0 | 1 | 1 | 0 | 0 | 1 |
| 11 | 1 | 0 | 0 | 0 | 0 | 3 |
| **12** | **1** | **1** | **1** | **1** | **1** | 2 |
| **13** | **1** | **0** | **1** | **1** | **1** | 1 |
| **14** | **0** | **1** | **0** | **1** | **1** | 1 |
| | | | | | | **27** |

| Set of variables |
|---|
| X2 = medium entry regulation (MEDREG) |
| X5= medium secondary school abandon rate (MEDABAN) |
| X7= high income per capita (HIGINCOM) |
| X14 = medium young population proportion (MEDYOUNPOP) |
| Y1 = high broadband performance |

*4.1.2 Panel A. Countries with High Broadband Performance*

| Row | Causal configurations |
|---|---|
| 6 | medreg*MEDABAN*HIGINCOME *MEDYOUNPOP |
| 7 | MEDREG*medaban*higincome * MEDYOUNPOP |
| 12 | MEDREG * MEDABAN * HIGINCOME * MEDYOUNPOP |
| 13 | MEDREG * medaban * HIGINCOME * MEDYOUNPOP |
| 14 | medreg * MEDABAN * higincome * MEDYOUNPOP |

*4.1.3 Panel B. First round of Simplification*

| Row | Causal configurations | New Term |
|---|---|---|
| **6+12** | MEDABAN*HIGINCOME *MEDYOUNPOP | 15 |
| 6+14 | medreg * MEDABAN * MEDYOUNPOP | 16 |
| 7+13 | MEDREG * medaban * MEDYOUNPOP | 17 |
| 12+13 | MEDREG * HIGINCOME * MEDYOUNPOP | 18 |

*4.1.4 Panel C. Second round of Simplification*

| Row | |
|---|---|
| 15 | MEDABAN*HIGINCOME *MEDYOUNPOP |
| 16 | medreg * MEDABAN * MEDYOUNPOP |
| 17 | MEDREG * medaban * MEDYOUNPOP |
| 18 | MEDREG * HIGINCOME * MEDYOUNPOP |

**High Broadband Performance =** MEDABAN*HIGINCOME *MEDYOUNPOP + medreg * MEDABAN * MEDYOUNPOP + MEDREG * medaban * MEDYOUNPOP + MEDREG * HIGINCOME * MEDYOUNPOP

High broadband performance in countries occurs when:

1. Medium secondary school abandonment rate, high income and medium young population are present.
2. Medium secondary school abandonment rate, and medium young population but medium entry regulation is absent.
3. Medium entry regulation and medium young population are present but medium secondary school abandonment rate is absent.
4. Medium entry regulation, high income and medium young population are present.

Looking at the results, a medium young population is a necessary, but not sufficient condition for all the observations. The other variables, medium secondary school abandon rate, high income and medium entry regulation, are neither necessary, nor sufficient conditions.

According to the results, there are basically two types of countries with high broadband performance: (1) countries with a medium secondary school abandonment rate and a young population with an entry regulation different from medium (Denmark and United Kingdom); (2) medium entry regulation is always associated with a medium young population in the other countries and a high income per capita (Luxemburg, Netherlands). However, high income would not be a necessary condition in some observations (Finland and United Kingdom). The results show that medium entry regulation with excellent economic and demographic conditions can lead to high broadband performance. Support was also found for H2, but medium entry regulation is less important than we initially thought and as such it is not a necessary or sufficient condition in many observations. Nevertheless, we found that medium entry regulation, in other observations, is present more than other types of entry regulation in high broadband performance countries.

## 4.2 Data Analysis for Medium Broadband Performance countries

### *4.2.1. Truth Table*

| | X2 | X5 | X8 | X11 | Y2 | N |
|---|---|---|---|---|---|---|
| **1** | **1** | **1** | **0** | **1** | **1** | 1 |
| **2** | **0** | **1** | **1** | **0** | **1** | 1 |
| **4** | **0** | **1** | **1** | **1** | **1** | 2 |
| **5** | **1** | **0** | **1** | **1** | **1** | 2 |
| **7** | **0** | **1** | **0** | **0** | **1** | 1 |
| 8 | **1** | 0 | 1 | 0 | 0 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **9** | **1** | **1** | **1** | **0** | **1** | 1 |
| 10 | 0 | 1 | 1 | 1 | 0 | 1 |
| **11** | **1** | **1** | **1** | **1** | **1** | 1 |
| **12** | **0** | **1** | **0** | **0** | **1** | 2 |
| **13** | **1** | **0** | **1** | **0** | **1** | 1 |
| 14 | 0 | 1 | 0 | 0 | 0 | 1 |
| 15 | **1** | 1 | 0 | 1 | 0 | 1 |
| **16** | **1** | **0** | **1** | **0** | **1** | 1 |
| 17 | **1** | 1 | 0 | 0 | 0 | 1 |
| 18 | 1 | 0 | 0 | 1 | 0 | 1 |
| 19 | 1 | 0 | 0 | 1 | 0 | 1 |
| 20 | 1 | 0 | 1 | 1 | 0 | 1 |
| **21** | **1** | **0** | **1** | **1** | **1** | 1 |
| **22** | **0** | **0** | **1** | **1** | **1** | 1 |
| 23 | **1** | 0 | 0 | 0 | 0 | 1 |
| 24 | **0** | 1 | 1 | 0 | 0 | 1 |
| | | | | | | 27 |

| Set of variables |
|---|
| X2 = medium entry regulation (MEDREG) |
| X5= medium secondary school abandon rate (MEDABAN) |
| X8 = medium income per capita (MEDINCOME) |
| X11 = medium population density (MEDENSITY) |
| X14 = medium young population proportion (MEDYOUNPOP) |
| Y2= medium broadband performance |

4.2.2 *Panel A. Country with Medium Broadband Performance*

| Row | Causal configurations |
|---|---|
| 1 | MEDREG*MEDABAN*medincome *MEDENSITY |
| 2 | medreg*MEDABAN*MEDINCOME*medensity |
| 4 | medreg*MEDABAN*MEDINCOME*MEDENSITY |
| 5 | MEDREG*medaban*MEDINCOME*MEDENSITY |
| 7 | medreg*MEDABAN*medincome*medensity |

| | |
|---|---|
| 10 | MEDREG*MEDABAN*MEDINCOME*medensity |
| 12 | MEDREG*MEDABAN*MEDINCOME*MEDENSITY |
| 14 | MEDREG*medaban*MEDINCOME*medensity |
| 25 | medreg*medaban*MEDINCOME*MEDENSITY |

*4.2.3 Panel B. First round of Simplification*

| Row | Causal configurations | New Term |
|---|---|---|
| **1+12** | MEDREG*MEDABAN*MEDENSITY | **26** |
| 2+4 | medreg*MEDABAN*MEDINCOME | 27 |
| 2+7 | medreg*MEDABAN *medensity | 28 |
| 4+25 | Medreg *MEDINCOME*MEDENSITY | 29 |
| 5+12 | MEDREG *MEDINCOME*MEDENSITY | **30** |
| 5+25 | medaban*MEDINCOME*MEDENSITY | 31 |
| 10+12 | MEDREG*MEDABAN*MEDINCOME | **32** |
| 10+14 | MEDREG*MEDINCOME*medensity | 33 |

*4.2.4 Panel C. Second round of Simplification*

| Row | Causal configurations | New Term |
|---|---|---|
| **26** | MEDREG*MEDABAN*MEDENSITY | 26 |
| **27+32** | MEDABAN*MEDINCOME | 27 |
| 29+30 | MEDINCOME*MEDENSITY | 28 |
| 30+33 | MEDREG *MEDINCOME | 29 |
| 28 | medreg*MEDABAN *medensity | 30 |
| 31 | medaban*MEDINCOME*MEDENSITY | 31 |

**Medium Broadband Performance =** MEDREG*MEDABAN*MEDENSITY +MEDABAN*MEDINCOME +MEDINCOME*MEDENSITY+ MEDREG *MEDINCOME+medreg*MEDABAN *medensity+ medaban*MEDINCOME*MEDENSITY

Medium broadband performance in countries occurs when:

1. Medium entry regulation, medium secondary school abandonment rate and medium density are present.
2. Medium secondary school abandonment rate and medium income are present.
3. Medium income and medium density are present.

4. Medium entry regulation and medium income are present.
5. Medium secondary school abandonment is present but medium entry regulation and medium density are absent.
6. Medium income and medium density are present but medium secondary school abandon rate is absent.

Looking at the observations, the variable, medium secondary school abandon, is the only sufficient but not necessary condition. The other variables like medium secondary school abandon, medium income and medium density are necessary, but not sufficient conditions in almost all the observations. Once again, it was observed that medium entry regulation was neither a necessary nor sufficient condition in many observations.

We could distinguish between three types of countries with medium broadband performance: First, we have countries with medium entry regulation, medium secondary school abandon rates and medium density (Austria and Hungary) or medium entry regulation and medium income (Belgium, Czech Republic, Germany, Italy, Malta, Portugal and Slovenia). Second, there are countries with medium abandon rates and medium incomes (Cyprus, France and Hungary) or medium incomes and medium density (Czech Republic, Portugal, Slovenia and Spain). Third, we have countries with medium secondary school abandon rates and medium incomes (Belgium, Cyprus, France, Germany and Hungary) or only medium secondary school abandon (Austria, Belgium, Cyprus, Estonia, France, Germany, Hungary, Ireland and Lithuania). The results show that medium entry regulation with medium economic and demographic conditions can lead to medium broadband performance. In support of H5, we found that medium entry regulation with medium economic and demographic conditions lead countries to medium performance. However, there is not evidenced at the moment for medium entry regulation with low income countries to medium performance.

## 4.3. Data Analysis for Low Broadband Performance countries

### *4.3.1 Truth Table*

| | X2 | X9 | X11 | Y3 | N |
|---|---|---|---|---|---|
| 1 | 1 | 0 | 1 | 0 | 5 |
| 2 | 0 | 0 | 0 | 0 | 4 |
| 3 | 0 | 1 | 1 | **1** | 1 |
| 4 | 0 | 0 | 1 | 0 | 4 |
| 5 | 0 | 1 | 0 | 0 | 1 |
| **6** | **1** | 0 | 0 | 0 | 6 |
| 7 | 0 | 0 | 1 | **1** | 1 |
| 8 | 0 | 1 | 0 | **1** | 1 |
| 9 | 1 | 1 | 1 | **1** | 2 |
| 10 | 1 | 0 | 1 | **1** | 1 |

| Set of variables |
|---|
| X2 = medium entry regulation (MEDREG) |
| X9= low income per capita (LOWINCOM) |
| X11 = medium population density (MEDENSITY) |
| Y3= low broadband performance |

#### *4.3.2 Panel A. Country with Medium Broadband Performance*

| Row | Causal configurations |
|---|---|
| 3 | medreg *LOWINCOM*MEDENSITY |
| 7 | medreg *lowincom*MEDENSITY |
| 8 | medreg *LOWINCOM*medensity |
| 9 | MEDREG *LOWINCOM*MEDENSITY |
| 10 | MEDREG *lowincom*MEDENSITY |

#### *4.3.3 Panel B. First round of Simplification*

| Row | Causal configurations | New Term |
|---|---|---|
| 3+7 | medreg * MEDENSITY | 11 |
| 3+8 | medreg *LOWINCOM | 12 |
| 3+9 | LOWINCOM*MEDENSITY | 13 |
| 7+10 | lowincom*MEDENSITY | 14 |
| 9+10 | MEDREG*MEDENSITY | 15 |

#### *4.3.4 Panel C. Second round of Simplification*

| Row | Causal configurations |
|---|---|
| 11 | medreg * MEDENSITY |
| 12 | medreg *LOWINCOM |
| 13 | LOWINCOM*MEDENSITY |
| 14 | lowincom*MEDENSITY |
| 15 | MEDREG*MEDENSITY |

**Low Broadband Performance** = medreg * MEDENSITY + medreg*LOWINCOM + LOWINCOM*MEDENSITY + lowincom*MEDENSITY+MEDREG*MEDENSITY

Low broadband performance in countries occurs when:

1. Medium density is present but medium entry regulation is absent.
2. Low income is present but medium entry regulation is absent.
3. Low income and medium density are present.
4. Medium density is present but low income is absent.
5. Medium entry regulation and medium density

Looking at the data, low income and medium density are not necessary conditions in all the observations; however, both variables are sufficient conditions. For some observations, medium density can lead high and medium income countries to low broadband performance. In this case it is possible to draw a distinction between two types of countries: (1) countries with medium density but not medium entry regulation (Bulgaria and Greece) or medium density with medium entry regulation (Poland, Romania and Slovakia) or medium density without low income (Greece); and (2) countries with low income but not market entry regulation (Latvia, Bulgaria) and low income with medium density (Slovakia, Romania, Poland and Bulgaria). It is important to point out that medium entry regulation is less present in the majority of observations. Other types of entry regulation appear to be working.

In relation to hypothesis 4 and 6, the results show that countries with low or high entry regulations, poor demographic and economic conditions have low broadband performance. Both hypotheses have support. In relation to hypothesis 5, results show that some countries (Latvia, Romania and Slovakia) in spite of having medium entry regulation have the lowest broadband performance. We did not find support for hypothesis 5. Medium entry regulation does not appear to improve the broadband performance if the economic and demographic conditions are very poor.

## 5. CONCLUSIONS

Preliminary empirical results show that the same regulatory policy can lead to different broadband outcomes across European nations. As a result, the main goal of this research has consisted of examining the interactions between regulatory variables and social and demographic variables on broadband performance. In considering this question, this study offers novel insight by taking into account the heterogeneity of the observations. This means that we have used a broadband performance indicator, which measures individual country performances rather than broadband penetration (e.g. indicators about broadband performance often do not take into account the size, demographics nor previous broadband performances). We have also examined the effects of demographic and educational factors that are important for telecommunication investments like young population rates, density and secondary school early leavers.

Previously, it was indicated that the relation between regulation and broadband performance is more complex than expected (Guillén and Suárez 2001), because there is a trade-off between competition, investment and innovation. It has been pointed out that there is a type of a medium regulation between heavy and light requirements that would be the most effective in order to promote investment and innovation (Aghion et al. 2005, Katz 2007 and 2008). At the same time, others have argued that entry regulation is the most effective tool to promote investment (Alesina et alii 2003; Friederiszick; Grajek and Röller 2007).

The results indicated that medium entry regulation with excellent economic and demographic conditions did, in fact, lead to high broadband performance; however, medium entry regulation was found to be less important than we optimistically thought, because it was neither a necessary nor sufficient condition to many observations. Despite this, medium entry regulation was observed to be more present than other types of entry regulations in high broadband performance countries. Similarly, medium entry regulation with medium economic and demographic conditions led to medium broadband

performances. This trend, however, was not clearly evidenced for low income countries, as the data did not indicate the expected medium performance. As such, the results revealed that medium population density is more related to low and medium broadband performance countries rather than high broadband performance countries. Furthermore, it is believed that low broadband performances could be a product of other types of entry regulations independent of medium entry, which are normally seen in such governments.

The qualitative comparative analysis (QCA) was chosen because it offers the advantages of the case-oriented and variable-oriented analyses. At present, there are not many studies about broadband performance that use this mixed approach. While the results may not be very conclusive, we believe that it will serve as an excellent springboard for further research into more specific-variable studies.

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