

Agiakloglou, Christos; Polemis, Michael

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## What determines demand for Telecommunications services? Evidence from the EU countries before and after liberalization

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# **What determines demand for Telecommunications services?**

## **Evidence from the EU countries before and after liberalization**

**Christos Agiakloglou\* and Michael Polemis**

University of Piraeus, Greece

### **Abstract**

This paper aims to investigate the main determinants of Telecommunications demand for European countries (EU). For this reason, a panel data set is used consisting of 19 EU countries over the period 1991-2010 capturing the years before and after the liberalization process. The goal is to clarify whether any changes in the demand of Telecommunications, as expressed by volume traffic in local, mobile and international market segments, are attributed to regulatory process or to some other major drivers so that policy implications can be drawn, taking also into account the magnitude of the relevant price elasticities. It turns out that the regulatory process does not seem to have significant impact on demand for Telecommunications services for the first period of liberalization.

**Keywords:** Telecommunications, Demand; Elasticities, Regulatory Process; Panel data

**JEL classifications:** L51, L1, L94, C2

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\*Corresponding author: Department of Economics, University of Piraeus, 80 Karaoli & Dimitriou Str, Piraeus 18534, Greece. *E-mail address:* [agiaklis@unipi.gr](mailto:agiaklis@unipi.gr).

## 1. INTRODUCTION

The Telecommunications sector in Europe has undergone substantial regulatory and institutional reorganizations over the last two decades. Specifically, the European Union has issued several directives (1998/84/EC, 2002/21/EC and 2009/140/EC) in order to enhance competition in Telecommunications. The primary goal of these Directives was to promote a common regulatory framework within the EU countries in Telecommunications, although, in practice, the implementation process varied considerably across member states.

As a result, the Telecommunications industry has changed drastically moving from a pure monopolistic environment to a regulated regime allowing for competition in the market, where the regulatory process was controlled by National Regulatory Authorities, known as NRAs. Indeed, up to early '90s the Telecommunications sector in Europe was governed by vertically integrated state-owned companies, whereas afterwards policy actions have taken to facilitate regulation in terms of the formulation of prices and the level of revenues to meet social and macroeconomic goals (Boylaud and Nicoletti, 2001). The liberalization of the industry was a necessary action to eliminate the distortions generated by the Public Telecommunications Operators (PTOs) that failed to meet social goals and to enhance competition in order to provide better quality of services at lower prices (Newbery, 2002). Meanwhile, the demand for Telecommunications services has overall increased over this period without being able to predetermine whether this increase is endorsed as a result of market opening or it is attributed to other macroeconomic and demographic factors, such as economic activity, population density, technology and human needs.

These two fundamental characteristics of the evolution of the Telecommunications sector in Europe, i.e., the regulatory process and the demand for Telecommunications, gave researchers the incentive to analyze and investigate this phenomenon. For example, Laffont and Tirole (1993 & 2000) focused their research on how regulation can be more efficient and they concluded that a good regulatory framework requires cost and demand information. Other studies examined the impact of structural reform measures, such as regulation, competition and privatization, on telecommunications performance, see for example Agiakloglou and Polemis (2015) and Wallsten (2001), whereas several other studies attempted to analyze the behavior of demand for Telecommunications using different empirical approaches, see for example, Agiakloglou and Karkalakos (2007), Agiakloglou and Yiannelis (2005), Madden and Savage (2000), Wright (1999), Garin Munoz and Perez Amaral (1998), Sandbach (1996), Acton and Vogelsand (1992) and Bewley and Fiebig (1988).

The truth is that determining demand conditions for Telecommunications is not only important for the operating companies but it is also vital for the NRAs. Existing companies need to know how their demand is formulated in order to design their strategies for their short run and long run internal and market goals. On the other hand, NRAs need to know market conditions in order to pursue policies and set rules regarding the structure, the conduct and the performance of the industry.

As it is known, demand conditions, as well as total revenues, are determined by quantities and prices of a product or a service. Specifically for the Telecommunications industry quantity is defined as the volume traffic of calls made in each market segment, such as, local, mobile and international calls. Hence, it is very interesting to study the impact of regulation, competition and privatization, known as structural reform elements, on Telecommunications demand for EU

countries before and after the liberalization period. The aim is to clarify whether the deregulation process has contributed significantly to demand changes in all market segments.

The paper is organized as follows. Section 2 presents the data and all variables used in the relevant econometric methodology, including the structural reform variables. Section 3 reports and analyzes the empirical results, whereas the concluding remarks as well as some policy implications are reported on Section 4.

## **2. DATA AND MODEL DESCRIPTION**

The demand for Telecommunications is mainly determined by two major components such as volume of calls and prices. We consider volume of calls as the main response variable of our analysis for each of the three market segments such as: a) local fixed to fixed telephone traffic in minutes (FIXED), b) domestic mobile telephone traffic in minutes (MOB) and c) total international outgoing fixed telephone traffic in minutes (ITER). These variables are obtained from the World Telecommunications / ICT Indicators database (June 2014) published by the International Telecommunications Union (ITU) for 19 EU countries over the period 1991 – 2010.<sup>1</sup>

As an effort to explain the behaviour of these response variables we consider three sets of explanatory variables namely: a) structural reform variables b) macroeconomic and demographic variables and c) prices of Telecommunications services. The first set of explanatory variables tries to capture the impact of structural reforms, such as regulation, competition and privatization, on the volume of

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<sup>1</sup> The E.U. countries are the following: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Poland, Portugal, Slovakia, Spain, Sweden, and the United Kingdom.

Telecommunications services. For this reason we use: a) for regulation the Regulatory Reform Index (RRI), an index that measures the level of regulation in Telecommunications for each country, taking values from 0, meaning perfectly deregulated market, to 6, meaning totally regulated market, b) for privatization a dummy variable, PRIV, taking the value of one when the percentage of shares in the PTO owned by the government is less than 50% and zero otherwise and c) for competition three dummy variables, COMP\_TRUNK, COMP\_MOB and COMP\_INTER, accounting for the competitive conditions prevailing in local-trunk, mobile and international market segments, respectively.<sup>2</sup> The data for all of the above variables is obtained directly from the OECD regulation database. It is interesting to point out that the RRI index is calculated by the methodology of Conway and Nicoletti (2006) taking into account several other elements of market structure and have been used in certain other empirical studies (see, for example, Li and Lyons, 2012, Pompei, 2013, Nesta *et al*, 2014).

The second set of variables includes some macroeconomic and demographic variables such as: a) the FRASER index, b) the number of active subscribers per 100 inhabitants for fixed and mobile market segments, i.e., F\_SUBS and M\_SUBS respectively, and c) population density (POP). Specifically, the FRASER index is a very important measure that declares the prevailing degree of economic risk in each country. This index takes values from zero to ten, with the highest value indicating economic freedom, and it is generated as a weighted average of five main macroeconomic factors such as: i) the size of government, ii) the legal system and property rights, iii) the access to sound money, iv) the freedom to trade internationally and v) the regulation of credit, labor and business (Gwartney *et al.*, 2012). Data for

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<sup>2</sup> Specifically, the competition dummy variables take the value of one if competition exists in each of the three market segments and zero otherwise.

the FRASER and for the aforementioned demographic variables is drawn from the Fraser Institute and from the World Development Indicators Database available from the World Bank respectively.

The third set of variables refers to prices charged by local and mobile providers obtained from the World Telecommunications / ICT Indicators database (June 2014) published by the ITU. Specifically, we use the price of a three minute local call to a fixed telephone line at pick rate, named as PRL, and the mobile cellular prepaid price of a three minute local call, at pick on net rate, named as PRM, as a proxy variable of a regular price of three minutes mobile call, in order to obtain own and cross price demand elasticities.<sup>3</sup>

The model adopted for this study is given by the following equation:

$$Y_{jit} = a_0 + a_1 RRI_{it} + a_2 COMP_{jt} + a_3 PRIV_{it} + a_4 X_{it} + \varepsilon_{it} \quad (1)$$

where  $j = 1, 2, 3$  denotes the three dependent variables, i.e., FIXED, MOB and INTER, for all countries ( $i$ ) at time  $t$  and the errors ( $\varepsilon_{it}$ ) are uncorrelated to each other.  $X_{it}$  is a vector of control variables described above. To account further for price elasticities for Fixed and Mobile segments model (1) is estimated using only prices for Fixed and Mobile calls as regressors.<sup>4</sup>

### 3. EMPIRICAL RESULTS

Model (1) is estimated using OLS with fixed effects for each of the three market segments and the results are reported on Table 1.<sup>5</sup> As can be seen from column one of

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<sup>3</sup> Data for uniformly defined prices of international calls was not available.

<sup>4</sup> All non-index variables are in natural logarithms so that own and cross price elasticities can be obtained directly.

<sup>5</sup> Model (1) is also estimated with random effects, but the Hausman (1978) test did not accept the null hypothesis of these effects.

this table none of the three structural reform variables affects the volume of fixed telephone traffic since their coefficients are not statistically significant. This result denotes that the deregulation process did not affect the volume of calls for this specific market segment, an outcome which is also consistent with basic descriptive statistics of the raw data.<sup>6</sup> One possible explanation for this finding can be attributed to the fact that the demand for this particular segment of the Telecommunications market has not been evolved as it should be expected, since other modes of Telecommunications have been risen and absorbed part of this volume traffic. Hence, the volume of fixed telephone traffic is affected by the other variables included in model (1).

Specifically, the number of active subscribers per 100 inhabitants for fixed telephone market has a positive and statistically significant impact on the level of traffic volume for this market segment. However, its magnitude is rather small, i.e., equal to 3.9%, meaning that a 100% increase (decrease) of the number of subscribers will lead to a roughly 4% increase (decrease) of the traffic volume, *ceteris paribus*. This small magnitude is probably attributed to the fact that subscribers tend to apply for fixed line connections not basically to make telephone calls, but to obtain other high value added complementary services bundled to a fixed line. Therefore, it is more important for firms, in terms of price strategy, to charge low prices for fixed telephony and high prices for all other complimentary services, such as internet and broadband connections, as well as cable TV.

On the other hand, the other two variables, population density and the level of economic risk, have a negative and statistically significant impact on the level of traffic volume for fixed telephony. Clearly, as the density of population increases, the

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<sup>6</sup> Indeed, from the analysis of raw data it is evident that the mean volume traffic for all EU countries before the liberalization period is slightly larger than its counterpart after the liberalization period.



volume of fixed telephone traffic decreases, as a result of a substitution effect. This means that people tend to substitute fixed telephony with other more advanced ways of communications, such as mobile telephone. Similarly, as the economic risk of a country decreases people use other means of communications rather than fixed telephony.

Column two of Table 1 reports the results obtained from the estimation of model (1) for the mobile market segment. As can be seen from this column the structural reform variables have controversial impact on the volume of mobile telephony. In particular, the level of competition has positive and statistically significant effect on volume. However, its magnitude is small, relatively to the constant term, since this variable is expressed as a dummy variable, indicating that competition has minor effect on the volume of mobile telephony. Likewise, the level of privatization is positive and statistically significant related with the volume of mobile telephony, having an estimate of 0.14, which is even lower to 0.51 of competition, indicating that more privatization does not necessarily lead to a large increase in volume. On the contrary, the volume of mobile telephony is not affected by the level of regulation, since its coefficient is not statistically significant. Perhaps, one possible explanation for this finding is attributed to the fact that the market for mobile telephony has opened instantly without the necessary regulatory enforcement period.

The other three variables, such as the number of Mobile subscribers, the population density and the Fraser index, do affect the behavior of the dependent variable, since the relevant coefficients are statistically significant. For example, the volume of mobile telephony is positively related to the number of Mobile subscribers, as expected and as it is also found in the case of fixed telephony. Similarly, positive impacts on the volume of mobile telephony have also the population density and the

Fraser index, a result though that it is opposite to the one obtained for fixed telephony. As a consequence, this finding supports the argument that people tend to use more mobile telephony instead of conventional means of communication, such as fixed telephony, as economic activity grows along with the population density. It is also interesting to point out that the magnitude of the coefficient of Fraser index is significantly larger than the estimates of the coefficients of the other two variables, such as M\_SUB and POP, indicating that the most important driver of mobile telephony is a stable economic environment which is evident in most of the EU countries.

Finally, column three of Table 1 depicts the estimated results by using the international volume traffic as the dependent variable. The effect of structural reform variables on international calls is different than that obtained for the other two market segments. In this case, only the level of competition has statistically significant effect on volume of international calls, while the other two structural reform variables, such as the level of privatization and regulation, do not play any role in determining the volume of this market segment. This finding can be justified by the fact that it is relatively easy for potential firms to enter the market and provide international calls at competitive prices. However, the magnitude of the estimated coefficient of competition is relatively small, as has been also reported for the other two market segments, indicating that competition has limited impact on international volume traffic.

As in the previous two market segments, the number of Fixed subscribers, the population density and the Fraser index, have statistically significant impact on the volume of international calls. However, all estimates are positive, compared to the fixed telephony market, indicating that as economy grows, along with population

density and the number of subscribers, the traffic for international calls increases. This result is attributed to the fact that people prefer to make their international calls through fixed line connections since calls are typically less expensive than calls made through mobile telephony. Similarly to the mobile market the magnitude of the coefficient of FRASER index is substantially greater than the other two control variables.

In addition, our findings can be also supported by estimating own and cross price elasticities for fixed and mobile telephony and the results are reported on Table 2. Column one of Table 2 reports the estimated results of regressing volume of fixed telephony on its own price and on the price of mobile telephony. The own price elasticity of fixed telephony is equal to -0.53, whereas the cross price elasticity of fixed telephony using prices of mobile telephony is equal to 0.15. All estimates are statistically significant and have the anticipated signs. More specifically, the absolute value of the own price elasticity of fixed telephony is less than one, indicating an inelastic demand, whereas the cross price elasticity, which is positive, suggesting the existence of a substitution effect. However, the magnitude of the cross price elasticity is small, close to zero, indicating that an increase of the price of the mobile telephony will only affect the demand for fixed telephony by a very small amount.

In contrast, the own price elasticity of mobile telephony is equal to -0.82, whereas the cross price elasticity of mobile telephony using prices of fixed telephony equals to 0.85, as can be seen from column two of Table 2. These results are obtained by regressing volume of mobile telephony on its own price and on the price of fixed telephony. Even in this case, all estimates are statistically significant and have the proper signs. The own price elasticity of mobile telephony is in absolute

terms less than one, indicating also an inelastic demand for this market, while the cross price elasticity is positive, declaring the substitution effect.

Nevertheless, if we try to compare the magnitudes of own and cross price elasticities obtained by the two market segments, some important results emerge. First, the magnitude of the own price elasticity of mobile telephony is larger in absolute terms than the one obtained in fixed telephony. This finding can be explained by the fact that fixed subscribers are less active to change provider than mobile subscribers, pointing out that the fixed mobile segment is more captive than the other segment. On the other hand, the magnitude of the cross price elasticity of the mobile telephony is almost six times larger than the magnitude of the counterpart cross price elasticity for fixed telephony, a result indicating that the substitution effect is more sensitive towards the mobile rather than the fixed telephony market to price changes.

#### **4. CONCLUDING REMARKS AND POLICY IMPLICATIONS**

This study tries to investigate the main determinants of Telecommunications demand for three market segments (local, mobile and international) before and after the liberalization process across the EU countries. The aim of this analysis is to explore the impact of structural reform variables, such as, regulation, competition and privatization, on traffic volume of calls in each of the three market segments taking also into account some other demographic and macroeconomic factors.

The empirical findings in a static fixed effects model using panel data suggest that structural reform variables do not have uniform impact on volume of calls in all

of the three market segments. In particular, for the local market none of the three structural reform variables play significant role in determining the volume of calls. On the contrary, competition and privatization do affect positively and statistically significant the volume of mobile calls, whereas the level of regulation does influence at all the volume of this market. Finally, for the international market only the level of competition prevails over the other two structural reform variables since its estimated coefficient is positively and highly statistically significant.

It is interesting to note that the aforementioned findings are in alignment with the existing economic conditions. The local market seems to remain unaltered by the liberalization process, simply because the tendency was to move away from this market to other niche markets, such as mobile. On the other hand, the rest two markets have been affected by this liberalization process mainly by competition since regulation reduced the legal entry barriers making the market more competitive. As a result, prices have dropped by the increased number of providers changing the overall demand pattern. The shifting of the demand especially from fixed to mobile can also be supported by the positive sign of the cross price elasticity. This result strongly suggests the existence of a substitution effect between fixed and mobile demand, favorable towards mobile telephony, revealing the robustness of the empirical findings.

Finally, all other macroeconomic and demographic variables do affect statistically significant the volume of calls in all three market segments, but, to some extent, at a different impact. As it is showed, the number of subscribers affects positively the volume of calls in all markets. However, the population density and the level of economic risk, have a negative impact on the level of traffic volume only for fixed telephony, a result that can be attributed to the fact that as economy and

technology grow the relative importance of fixed telephony to the overall Telecommunications sector decreases.

Hence, it turns out that the regulatory process did not have substantial impact on Telecommunications demand for the first period of liberalization. The demand for Telecommunications for the three examined market segments seems to be affected by other factors and, therefore, policy makers should not pursue strategies towards to a more regulated industry. The opening of the Telecommunications sector, due to regulatory efforts, gave the incentive for several companies to enter the market offering products and services at competitive prices. As a result these companies gained market shares from the incumbent but without being able to increase the demand for Telecommunications.

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## List of Tables

**Table 1:** Fixed effects results

<b>Coefficients</b>	<b>Fixed Telephony</b>	<b>Mobile Telephony</b>	<b>International Telephony</b>
Constant	27.765*** (40.557)	16.038*** (15.153)	14.637*** (14.330)
RRI	0.015 (1.074)	0.001 (0.051)	0.043* (1.613)
COMP_TRUNK	-0.053 (-1.121)	-	-
COMP_MOB	-	0.511*** (4.696)	-
COMP_INTER	-	-	0.262*** (3.968)
PRIV	-0.009 (-0.159)	0.144*** (2.448)	-0.0003 (-0.006)
F_SUBS	0.039*** (15.440)	-	-
M_SUBS	-	0.021*** (26.654)	-
POP	-0.022*** (-8.493)	0.019*** (3.648)	0.022*** (4.267)
FRASER	-0.364*** (-5.431)	0.243*** (3.403)	0.338*** (4.792)
<b>Diagnostics</b>			
Observations	180	207	335
Adjusted R <sup>2</sup>	0.98	0.97	0.92
S.E of regression	0.22	0.28	0.34
F-statistic	728.16*** [0.00]	360.91*** [0.00]	168.88*** [0.00]

Note: Robust standard errors are in parentheses. The numbers in square brackets are the p-values. Significant at \*\*\*1%, \*\*5% and \*10% respectively.

**Table 2: Own and Cross Price Elasticities**

<b>Coefficients</b>	<b>Fixed Telephony</b>	<b>Mobile Telephony</b>
Constant	23.202*** (196.409)	24.245*** (75.086)
PRL	-0.531*** (-3.728)	0.855*** (4.938)
PRM	0.158*** (2.833)	-0.822*** (-6.367)
<b>Diagnostics</b>		
Observations	146	157
Adjusted R <sup>2</sup>	0.95	0.75
S.E of regression	0.29	0.77
F-statistic	170.43*** [0.00]	24.73*** [0.00]

Note: Robust standard errors are in parentheses. The numbers in square brackets are the p-values. Significant at \*\*\*1%, \*\*5% and \*10% respectively.