Competitive dynamics in Greek telecommunications: The effects of telecommunications reform on market structure

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Abstract
This paper analyses the implications of liberalization on market structure in the Greek telecommunication market from 1992 to 2005. In particular, we investigate the influence of the sector's reform on market structure and the possible explanatory factors of these dependent variable. The data refers to 44 of the most prominent companies of fixed telephony, mobile telephony and internet services and was compiled by means of interviews with the help of a questionnaire. The data was evaluated both descriptively and econometrically (Panel Feasible Generalised Least Squares – FGLS). Our descriptive analysis concluded that liberalization of the telecommunication market reduced its concentration degree and increased competition. This conclusion is supported by other research studies. The econometric research showed that both private ownership and specialized personnel in the commercial and technical sector seem to positively influence the companies' market share. In this way, the present article offers useful information about a field that continues to be characterized by a vast researching deficit.

Keywords: Greece, Telecommunication, Market Structure, Competition, Privatization, Regulation

Introduction

From its early stages, the telecommunication sector operated in every country under the status of strict state monopoly and almost absolute protectionism (Nestor and Mahboobi, 1999, Wilson and Zhou, 2001, Spiller and Cardili, 1997, Shirley and Walsh, 2000, Sheshinski and Lopez-Calva, 1998, Smith, 1995). However, in the course of time, the rising customer demand for higher quality, new services and lower prices led to necessary structural changes (Koski, 2002, OECD, 1995, Heracleous, 1999, Nestor and Mahboobi, 1999, Gual and Waverman, 1998).The reform process originated during the 1970's in the USA and from the beginning of the 1980's in Great Britain and Japan where from it consecutively spread to the other OECD member states. Within the European Union the reform commenced in 1984 and was completed in 1998.

This tendency, worldwide known as "deregulation", aimed at the establishment of essential institutional changes that will upgrade the role of market mechanism the function of economic sectors by introducing the competition factors and rules of deregulation process. These changes progressively altered the role of state, which was shifted by the liability of property and management in formation of new policy and exercise of necessary regulating policy (International Chamber of Commerce 2004, Gonenc et al. 2000, Wilson & Zhou 2001, Gasmi et al. 2000, OECD 1997).

More specifically, the internationally applied structural changes in the telecommunication sector, even if they produced important national differences in their rate of promotion and in their conditions of application, were characterized, in general terms, by three common points (Parker 2004, Ricketts 2004, Omran 2004, Levi-Faur 2003, Nicoletti and Scarpetta 2003, Goldstein 2003, Koski 2002, Shirley and Walsh 2000, Ramaswamy and Van Glinow 2000, Li et al. 2000):

- The first point is the increasing participation of private sector in market activities. This is expressed by the entry of new companies and by the privatization of traditional telecommunication organisms.
- The second point is the introduction and the intensity of competition with the functional division of vertical integration processes that characterize the production and rendering of services. Thus, the introduction of competition has to do with the increase of the number of available telecommunication services and suppliers, as well with the type and number of networks that constitutes the telecommunication infrastructure.
- The third point refers to the configuration of a suitable regulating frame for the normal function of competition. Thus, both specialized regulating mechanisms and independent regulating authorities are constituted.

The particular objectives of these structural changes are summarized as below (Booz-Allen& Hamilton 1997):

- in the privatization of government monopolies,
- in the undertaking by private sector of economic activities that were previously directly controlled by governments,
- in the formation of new regulating rules with regard to network sectors in order to facilitate the access to services by new suppliers that previously were not subjected to competition process,
- in the constitution of markets from zero point, in order to facilitate the participation in new transactions of new players,
- in the introduction of market competition in sectors where (not financial) subjects of public interest were achieved through the existence of a non competitive (monopolistic) business environment,
- in the determination of prices based on mechanism of market and access to the markets that were previously ruled by many institutional restrictions and obstacles.

A number of empirical studies investigated the impact of the above policies, inter alia, on market structure either econometrically (using panel data analysis) or descriptively. More specifically, as far as the econometric ones are concerned, Boyland and Nicoletti (2000) showed that in 23 OECD states the newly introduced companies increased their market share. Similarly, Ros (1999) used an extensive sample of countries to show that the higher the cost of a monthly subscription, the bigger the increase of the principal telephone lines per 100 inhabitants is.

Within the framework of descriptive studies (which outnumber the former ones), Min (1999) concluded that the reform of the Japanese telecommunication sector led to the establishment of numerous new companies (especially multinational ones). Hughes and Phillips (1999) analyzed the reform policy in the USA and found out that many new companies were introduced in the market, mergers - acquisitions took

place and international alliances were established. Haggarty et al. (2003) showed that the implemented reform policy in the telecommunication sector in Ghana has prompted the introduction of new companies in the mobile telephony market, which led to the rise of competition

The liberalization of the telecommunication market had considerable consequences in Greece too (which as an EU member country has implemented the respective European policy in the specific industry). More specifically, from the beginning of the 1990's the market is gradually liberalized, the National Telecommunications Organization (NTO) is privatized, new private companies are launched, and the Hellenic Telecommunications and Post Commission (HTPC) is established as an independent regulatory authority. The reform policy is completed in 2001.

This article examines the implications of the liberalization in fixed telephony, mobile telephony and the internet markets. In particular, we investigate:

a) the influence of the sector's reform on market structure (descriptive analysis) and
b) the possible explanatory factors of these dependent variable(econometric analysis).

Our original sample concerns 44 of the most prominent enterprises that were active in the Greek telecommunication market during the time period 1992 – 2005. We collected the primary data concerning these companies by means of interviews (see Appendix).

Model specification, variables and data

As far as the econometric level is concerned, we used Panel Feasible Generalised Least Squares (FGLS). FGLS is an appropriate tool for samples such as our own, composed by intersectoral data that extend to more than one time periods, and without correlation between the unobserved effects and the interpretative variables (Hsiao, 2003, Wooldridge, 2002). Analytically,

Model

There are cases where a sample is composed by cross-section units i=1,2,…,n for a number of time periods t=1,2,…,T. A data set which combines cross-section data and time series is called "panel data". The use of panel data exhibits a number of advantages in relation to the use of either only cross-section data or only time series. The main advantage is that the heterogeneity of the cross-section data can be assessed. Moreover, panel data offer more complete information, more variance which can be of econometric use, a lesser degree of multicollinearity, more degrees of freedom and more effective estimates (Hsiao, 2003).

For panel data analysis we use the following basic model (Wooldridge, 2002):

$$y_{it} = \mathbf{x}'_{it}\boldsymbol{\beta} + c_i + u_{it} \quad (1)$$

where y_{it} is the dependant variable, $\mathbf{x}_{it} = (x_{it,1}, x_{it,2}, ..., x_{it,k})'$ is a vector of explanatory variables, $\boldsymbol{\beta} = (b_1, b_2, ..., b_k)'$ is a vector of the coefficients of the explanatory variables to be estimated and $\mathbf{c_i}$ are the time-invariant unobserved cross-sectional effects.

In the relevant literature the interest focuses on the choice of the appropriate method of estimation. The choice depends on the hypothesis that the unobserved effects c_i are correlated (or not) with the explanatory variables. Thus there are two cases:

- **c_i are correlated with x_{it}**

In this case, the "fixed effects" method is used according to which the variables are expressed as deviations from their mean values, i.e. model (1) becomes:

$$y_{it} - \bar{y}_i = (\mathbf{x}_{it} - \bar{\mathbf{x}}_i)'\boldsymbol{\beta} + (u_{it} - \hat{u}_i) \qquad (2)$$

Model (2) can be estimated by ordinary least squares (OLS) in order to produce reliable estimators.

- **c_i are not correlated with x_{it}**

In this case, the covariance between the unobserved effects and the explanatory variables is zero for all t [$\mathrm{Cov}(\mathbf{x}_{it}, c_i) = 0, t = 1,2,...,T$] and the unobserved effects are mutually independent random variables normally distributed with zero mean and constant variance. In this case, model (1) becomes:

$$y_{it} = b_0 + \mathbf{x}'_{it}\boldsymbol{\beta} + v_{it} \quad \text{where} \quad v_{it} = c_i + u_{it} \qquad (3)$$

The error term v_{it} exhibits positive serial correlation with

$$\mathrm{Corr}(v_{it}, v_{is}) = \sigma_c^2/(\sigma_c^2 + \sigma_u^2), \quad t \neq s$$

The appropriate method for estimating model (3) is the generalized least squares (GLS) by introducing the following transformation:

$$\lambda = 1 - \left(\frac{\sigma_c^2}{T\sigma_c^2 + \sigma_u^2} \right)^{1/2}$$

Then the following model of the transformed variables can be estimated with OLS:

$$y_{it} - \lambda\bar{y}_i = b_0(1-\lambda) + (\mathbf{x}_{it} - \lambda\bar{\mathbf{x}}_i)'\boldsymbol{\beta} + (v_{it} - \lambda\bar{v}_i) \qquad (4)$$

In practice, the value of λ is unknown. Therefore, in order to estimate model (3) the feasible generalized least squares (FGLS) method is used, according to which the estimated λ is used and the new model is estimated with OLS:

$$\hat{\lambda} = 1 - \left[\frac{1}{1 + \frac{\hat{\sigma}_c^2}{T\hat{\sigma}_u^2}} \right]^{1/2} \quad \text{where } \hat{\sigma}_c^2 \text{ και } \hat{\sigma}_u^2 \text{ are consistent estimates}$$

of σ_c^2 και σ_u^2 with:

$$\hat{\sigma}_c^2 = \left[NT(T-1)/2 - (K+1)\right]^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T-1} \sum_{s=t+1}^{T} \hat{v}_{it} \hat{v}_{is}$$

$$\hat{\sigma}_u^2 = \hat{\sigma}_v^2 - \hat{\sigma}_c^2$$

$\hat{v}_{it}$, $\hat{v}_i$ and $\hat{\sigma}_v^2$ are based on OLS residuals of (3).

Above mentioned, in this paper we assume that the unobserved variables are not correlated with the other independent variables. This hypothesis prompts us to use the feasible generalized least squares (FGLS) method with random effects in order to estimate our model. Moreover, the *F*–test is used, in order to examine the statistical significance of the variables under consideration.

Variables

Variables were selected after having taken respective econometric studies into account, but were also dictated by the availability of historical information concerning the most extensive possible time period and the existence of efficient. Thus, the variables of econometric models are formed as follows (Table 1): market shares in fixed telephony (Sharelocal, Sharetrunk, Sharetomobil, ShareEU, ShareUSA), in internet (Shareinter) and in mobile telephony Sharemobil) are taken every time as a dependent variable into account. As independent variables we consider pricing for eight kinds of phone calls and more specifically, local calls (Pricelocal), long distance calls (Pricetrunk), calls to mobiles (Pricetomobil), international calls to EU countries (PriceEU) and the USA (PriceUSA), the annual standard subscription (PSTN 56k) for internet services (Priceinter) and the minimum charge per second for mobile telephony (Pricemobil). Furthermore, as independent variables we employ the companies' size (Size), the ownership (Own) and five employment categories, i.e. the administrative personnel's number (Man), the commercial personnel's number (Com), the technical personnel's number (Tech), the personnel's number with a university degree (Uedu) and the personnel's number with a high school degree and elementary degree (Bedu). This specialization is implemented for the first time in literature.

Available references for all the above variables are presented in Table 1.

Table 1: Econometric analysis variables

Variable	Description	Available References
Pricelocal	Local call charge per minute	Boyland and Nicoletti 2000, Wallsten 2001, Nicoletti 2001, Ros 1999
Pricetrunk	Long distance call charge per minute	
Pricetomobil	Call charge to mobiles per minute	
PriceEU	Call charge to the EU per minute	
PriceUSA	Call charge to the USA per minute	
Priceinter	Monthly fixed charges of an annual standard subscription (PSTN 56k)	

Pricemobil	Minimum call charge per second	
Own	Company ownership in the research (state=0, private=1)	Boyland and Nicoletti 2000, Nicoletti 2001, Ros 1999, Staranczak et al. 1994, Jha and Majumbar 1999, Madden et al. 2003
Size	Company size in the research (small=0, big=1)	Harper 2002, Staranczak et al. 1994, Jha and Majumbar 1999
Sharelocal	Market share regarding local calls owned by a company (%)	Boyland and Nicoletti 2000, Nicoletti 2001
Sharetrunk	Market share regarding long distance calls owned by a company (%)	
Sharetomobil	Market share regarding calls to mobiles owned by a company (%)	
ShareEU	Market share regarding international calls to the EU owned by a company (%)	
ShareUSA	Market share regarding international calls to the USA owned by a company (%)	
Shareinter	Market share owned by a company (%)	
Sharemobil	Market share owned by a company (%)	
Man	Number of administrative-financial personnel	Not available
Com	Number of commercial personnel	Not available
Tech	Number of technical personnel	Not available
Uedu	Number of personnel with university degree	Not available
Bedu	Number of personnel with high school degree	Not available

Data

We gathered our primary data as follows. From the Companies' Register of the Hellenic Telecommunications and Post Commission (HTPC) we identified a total of 108 providers of main telecommunication services. Field research was conducted in 2005, in three phases. During the first phase, the questionnaire was edited and improved with the help of a pilot interview. During the second phase telephone contact was made with every company in the field followed by the questionnaire which was sent by e-mail. During the third phase telephone contact was resumed in order to finalize the meetings with the competent company executives. Finally, 44 companies took part in the research.

Results and discussion

Descriptive statistics

The complete liberalization of the Greek market triggered the continuous introduction of new telecommunication companies and the competition's intensification. From a single public company active in 1992 the telecommunication companies in the three main services' categories amounted to 108 in 2006. This development changed market

structure fundamentally (Table 2). More specifically, as far as fixed telephony market is concerned, concentration index Herfindahl fell from 1 (monopoly) in 2001 to 0.51 in 2005. In the mobile telephony market the specific index fell from 0.40 in 1998 to 0.31 in 2005. Finally, in the internet market, the index fell from 0.50 in 1998 to 0.26 in 2005. As a conclusion, fixed telephony and internet markets showed the biggest rise in competition diachronically, whereas mobile telephony market (which had an oligopolistic structure with intense competition from the beginning) exhibited the lowest rise.

Table 2: The level of market concentration regarding fixed telephony, mobile telephony and Internet (Herfindahl Index)

	1998	1999	2000	2001	2002	2003	2004	2005
Herfindahl Index								
Fixed telephony	-	-	-	1	0,92	0,77	0,57	0,51
Mobile telephony	0,40	0,34	0,33	0,33	0,33	0,32	0,31	0,31
Internet	0,50	0,50	0,50	0,44	0,37	0,30	0,27	0,26

Source: Fixed telephony companies, Mobile telephony companies, Internet companies

In general, Table 3 showed that 79.6% of the companies expressed the view that the competition in the Greek telecommunication market was markedly to very markedly intense (average rate of responses 3.88). The main competition fields were pricing policy (93.2% of the companies, average rate of responses 4.60), promotion and marketing practices (93.2%, 4.37) and quality in customer's services (52.2%, 3.47). On the contrary, competition regarding technology and experienced personnel was of lesser importance, since young personnel with seminar education was often employed.

Table 3: The conditions and characteristics of competition in the Greek telecommunications market (high/low evaluations and average rate of responses)

	none or scarcely	much or very much	average rate of responses
Competition intensity	2,3%	79,6%	3,88
Competition in technology	11,4%	36,3%	3,28
Competition in promotion and marketing policies	0,0	93,2%	4,37
Competition in quality of customers' service	11,4%	52,2%	3,47
Competition in pricing policy	0,0	93,2%	4,60
Competition in experienced and expert personnel	27,3%	20,5%	2,91

Source: data research

Econometric results

Out of the total econometric models it is concluded that market's structure most important explanatory variables were private ownership and commercial and technical personnel (Table 4). Then followed company size and pricing of provided services. First of all, private ownership influenced market share positively regarding local, long distance and international calls (at significance level 1%) as well as calls to mobiles (at significance level 10%). Hence, the market share

of private companies substantially increased in relation to the state owned ones.

Second, the company's commercial and technical personnel had a positive impact on market share. This conclusion can be satisfactorily explained, if related to the results in Table 3, where marketing, customer service and technology constitute significant competitive parameters in this sector. To be more precise, we observed that the commercial personnel was related positively to the market share concerning long distance and international calls(at significance level 10%), whereas the technical personnel found itself at significance level 5%. The internet services market formed an exception, where the commercial and technical personnel influenced market share negatively (at significance level 5%). We assume that high operational costs resulted from a vast number of employees counterbalanced any advantages relating to high commercial and technical expertise in the specific subsector.

Third, market share was influenced positively by the company size. The larger a company was the larger the market share at least in some subsectors such as internet and mobile telephony (at significance level 1% respectively). Harper, (2002) used 554 companies from the Czech Republic as a sample to conclude that the big companies showed a decrease in their sales, without however to trying to suggest any correlations between them.

Fourth, the pricing of provided services presented a negative relation to the market share. Specifically, the lower a company prices call services to mobiles and international calls was, the higher its market share at significance level 5% and 10%. The internet market was an exception.

Table 4: Market structure

	Independent Variables							
Dependent Variables *F*-test	**Price**	**Size**	**Own**	**Man**	**Com**	**Tech**	**Uedu**	**Bedu**
Sharelocal	-697,432 (1443,6)	0,690 (1,327)	14,764* (4,376)	0,177 (0,171)	0,193 (0,136)	0,236 (0,144)	-0,160 (0,142)	-0,190 (0,139)	4,975*
Sharetrunk	-72,074 (55,43)	0,788 (0,934)	14,270* (3,375)	0,189 (0,119)	0,208*** (0,102)	0,256** (0,107)	-0,177 (0,104)	-0,204*** (0,101)	6,272*
Sharetomobil	-39,120**	0,854	8,643*** (16,020)	-0,014 (0,960)	0,034 (4,360)	0,056 (0,152)	-0,0004 (0,127)	-0,022 (0,130)	8,310* (0,130)
ShareEU	-48,010***	0,520	11,668* (27,512)	0,145 (0,765)	0,179*** (3,652)	0,223** (0,118)	-0,146 (0,098)	-0,169 (0,102)	6,730* (0,099)
ShareUSA	-45,195	0,545	11,893* (26,609)	0,148 (0,777)	0,181*** (3,646)	0,224** (0,119)	-0,147 (0,099)	-0,171 (0,104)	6,671* (0,100)

Shareinter	2,123*	31,830*	3,170	-0,852***	-1,135**	-1,033**	0,952**	0,924***	9,568*
		(0,639)	(4,586)	(7,113)	(0,462)	(0,477)	(0,459)	(0,436)	(0,469)
Sharemobil	-633,011	24,548*	1,753	0,256	0,159	0,253	-0,211	-0,180	7,396*
		(1825,56)	(6,565)	(9,866)	(0,283)	(0,285)	(0,301)	(0,283)	(0,293)

Note: Regressions have been estimated using Panel Feasible Generalised Least Squares (FGLS) method with random effects. Regressions include a constant as well, which does not appear on the table due to lack of space. Numbers in parentheses are the typical errors of the estimated parameters. F-test controls the joint statistical significance of the independent variables. If the absolute value of the estimated variable is <0,0001, then it is expressed with ≈0. ***, **, * indicate statistical significance at level 10%, 5% and 1%, respectively.

Conclusion

In this article we have investigated if and to what extent the liberalization of the telecommunication market in Greece influenced its structure. In order to achieve this, we conducted an empirical research in 44 of the most important companies in the sector in 2005 and we gathered data for the period 1992-2005. We elaborated these data descriptively and econometrically using the FGLS method within the framework of panel data analysis. This method is regarded appropriate for our sample which is compiled by intersectoral data for more than one time periods and there is no correlation between the unobserved effects and interpretative variables.

Our descriptive research showed that market liberalization indeed increased competition and decreased the concentration degree (based on Herfindahl index). In this way, our results confirmed those of other research studies conducted in developed as well as in developing economies (see *inter alia* the works of Min, 1999, Athreya 1996 and Sinha, 1996, Haggarty and Shirley, 2003, Min and Ypsilantis, 1999, Xavier, 1996, Sato and Ypsilantis, 2000, Hughes and Phillips, 1999, Wallsten, 2001, Ypsilantis and Min, 2001, Sacripanti, 1999, Vanyai, 1998, Xavier and Ypsilantis, 2001).

Econometric analysis, on the other hand, took a step further to investigate the most important explanatory variables of market shares. As regards market shares, the main conclusion was that within the new liberalized telecommunication market, private companies were "the winners" to the disadvantage of the state companies. Other factors having a positive effect on the market shares were the expert commercial and technical personnel, the size of companies and a favorable to the consumers pricing policy.

We realized that during the present phase, in the corresponding literature the econometric research has some quantitative deficits comparatively to the descriptive analyses. Consequently, in the future the objective research should be the extension of the research also in other economic-political settings in order to have a better comparison and a possible generalization of our conclusions.

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ANNEX: «RESEARCH QUESTIONNAIRE»

1. To what extent do you think there is competition in the Greek telecommunications market?

1	2	3	4	5

1= none, 2= scarcely, 3= fairly, 4= much, 5= very much

2. To what extent do you think that the current competition is about technology (technological competition)?

1	2	3	4	5

1= none, 2= scarcely, 3= fairly, 4= much, 5= very much

3. To what extent do you think that the current competition is about promotion and marketing?

1	2	3	4	5

1= none, 2= scarcely, 3= fairly, 4= much, 5= very much

4. To what extent do you think that the current competition is about customer service?

1	2	3	4	5

1= none, 2= scarcely, 3= fairly, 4= much, 5= very much

5. To what extent do you think that the current competition is about pricing policy?

1	2	3	4	5

1= none, 2= scarcely, 3= fairly, 4= much, 5= very much

6. To what extent do you think that the current competition is about experienced and expert personnel?

1	2	3	4	5

1= none, 2= scarcely, 3= fairly, 4= much, 5= very much