

An empirical model for later entrants market share development in the mobile phone market: An application in the Greek market

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Abstract— This paper presents an empirical model for the forecasting of the market share development of a later entrant in the mobile phone market within a country. The proposed model is an attempt to predict the evolution of the new entrant based on the time of entry, the estimated diffusion shape calculated by the Linear Logistic model, the change in penetration rate and the Herfindahl-Hirschman Index. An application in the Greek market is also presented and analysed. The model can be used as a first simple evaluation method before the act of entry, merger or acquisition by potential investors, combined with methods that use other important variables.

Index Terms— Mobile diffusion forecasting, Linear Logistic model, Market share development, Market concentration

I. INTRODUCTION

HERE is a large number of studies, mainly empirical, that underline the early mover advantages, as compared to later entrants in a market. Mostly in management and marketing journals, empirical studies highlight the association between order of entry and market share, and result to the market pioneer's advantage in the "long-run" market share development [1-3]. Recently, the early mover advantages is demonstrated through an empirical analysis of European mobile phone markets [4]. In this work, a dynamic model and a series of static models are used to investigate the impact of market concentration and the penetration rate on the development of market shares of entrants. Gruber and Verboven empirically result to the positive relationship between the diffusion rate of mobile telephony in a country and the degree of competition [5, 6]. The importance and accuracy of empirical studies, that record the association between order of entry and market share development of a player, have been questioned by authors Golder and Tellis, mainly on the ground that most of them have potential

limitations. They argue that entry is usually treated as an exogenous parameter [7].

Mobile telecommunications markets are appropriate for such studies, as they usually involve a limited number of players and they can be examined as oligopolistic ones. Furthermore, they reach their maturity in less time than other markets, so a country's market development can be easily examined with only few years of observations.

The observation of the mobile telephony development so far is a very popular field of research. The penetration rates in different European countries follow an S-curve and have already exceeded the "inflection point" [4]. This is the critical time period in which the maximum number of mobile adoptions happens. The saturation point of the observed countries has not been achieved yet, although some penetration rates have already reached 100% or higher over population. This can easily be explained by the fact that many people use more than one recorded mobile numbers. So, one can say that we are in an appropriate period to make mature assumptions for the causes of mobile telephony's progress so far and to estimate in an accurate way its future development.

This paper focuses on the market share development of later entrants in the mobile market, given the availability of historical data and the use of forecasting. Studies already conducted have recorded, explained and proved the later entrant's disadvantage in the competition run, usually by illustrating the same shape for later entrants' market share development. It can be easily observed that the market shares increase rapidly in the first months after market introduction and slow down and stabilize to a more or less steady area of market shares after a period. The usage of an empirical model to illustrate the market share development later entrants in several countries, based on historical data, as well as dummies and parameters sets for each case separately is firstly attempted in [4].

To the best of the authors' knowledge, this is the first paper presenting a similar empirical model applicable even before the actual entry of the new operator. In this work, the model is applied in the Greek mobile market, although the same form could be used in several countries. The model avoids the use of dummies and includes time since the first appearance of subscribers in the country. The Herfindahl-Hirschman Index

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(HHI) of the market is taken into consideration, measured the moment before the entry. Finally, the model can provide forecasting as well. The findings of such a methodology could be used by analysts and potential investors as a first method of evaluating the potential market share before entering as a new player. As the model does not include factors such as marketing, brand name, funding, rate of churn, switching costs and brand name, it can give only a simple orientation towards the new entrant's market share development. Nevertheless, this evaluation tool can be used in combination with other methods that include such factors to present more accurate results.

The rest of the paper is organized as follows. The next section provides an overview of the Greek mobile phone market. Section III discusses the structure of the model and the choice of the variables. Section IV gives an overview of the results after the model's application in the considered mobile market. Finally, Section V concludes.

II. THE GREEK MOBILE PHONE MARKET

The Greek mobile telecommunications market is one of the most dynamic and profitable in Europe. It has ordinary, but also unique characteristics and, therefore, its analysis reveals interesting outcomes. Greece is the only country that did not have any analog cellular network. On the contrary, it was the first country that proceeded to a sealed bid auctions in order to award licenses [8].

Today, the Greek mobile market acts in an oligopolistic manner, as there are currently three mobile telecom operators: Vodafone, Wind and Cosmote. The market is regulated by an independent authority, the National Telecommunications and Post Commission (EETT, <http://www.eett.gr>), while the corresponding Ministry for Transport and Communications (MTC) is responsible for drafting legislation. The first entrants in the market where Panafon (now Vodafone) and STET (later TIM and from mid-2007 WIND) launching GSM 900 networks in 1993. Greece's incumbent fixed-line operator, OTE entered the mobile market later on, through its subsidiary, Cosmote. Besides its GSM 900 network, it pioneered in launching a GSM 1800 network in April 1998, followed by the other two operators by 2000. The market share's development of European later entrants from 1998 onwards is recorded in [4]. As illustrated in the authors' work, Cosmote's progress has been surprisingly very successful compared to other European cases, even though it was the third entrant in the Greek mobile market. As pointed out, it is a unique case of rapid market share development, possibly interpreted by the fact that it is a subsidiary of the former state monopolistic and national incumbent of fixed telephony market, OTE, which is the strongest brand name in Greek communications. Other authors argued that Cosmote's rapid market share increase is interpreted mainly by its particularly successful marketing strategy [9].

The last player, Q-Telecom, entered the market in 2002. It was a subsidiary of Greek IT firm InfoQuest that provided

services as a mobile network operator in Athens and as a mobile virtual network operator (MVNO) in other major cities through Vodafone's network. Even though its market share was relatively low during the first years of operation, the use of aggressive marketing and successful advertising resulted to a 96% growth in 2004, as compared to 2003.

In Fig. 1 the development of the number of subscribers for each operator for the period 1996-2006 is illustrated.

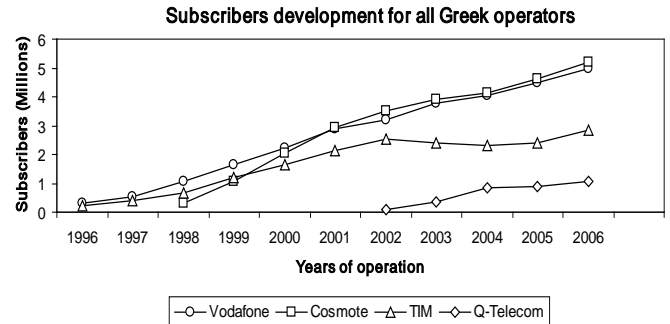


Fig. 1 Subscribers development for all Greek operators

TABLE I
MARKET PLAYERS AND THEIR DATE OF ENTRY IN GREECE

Operator	Date of introduction
Vodafone(Panafon)	(July) 1993
TIM (STET Hellas)	(July) 1993
Cosmote	(April) 1998
Infoquest (Q-Telecom)	(June) 2002

III. THE MODEL

In the spirit of Kalyanaram and Urban (1992) and following recently the empirical model proposed in [4], the model of this paper has the following form:

$$M_{it} = \gamma(1 - e^{-\beta t}) \quad \text{Eq. 1}$$

where M_{it} is the market share of firm i , t years after introduction and t is the time measured in years after introduction. The first parameter (γ) captures the «long-run» market share and the second (β) the speed with which the market converges to this level. Their expressions are presented below:

$$M_{it} = [(1/N) * [p^2 + HHI + (S - p)^2]] * [1 - e^{-((HHI)^2 + \Delta p_{t-1} + p_{t-1})}] \quad \text{Eq. 2}$$

The model avoids using dummies and parameters for the specific firm and country characteristics, that are determined by personal judgments, to be applicable to every market but with the cost of less accurate predictions. It also introduces N , which equals to the years since the first mobile subscribers of the country. As mentioned before, the earlier a player enters the market, the greater potential the player has, to gain larger market share [4]. Estimation of the market evolution in terms of diffusion rate and saturation level is based on the Linear Logistic model, in order to capture the “long-run” market share in a more accurate way. S is the forecasted saturation point of penetration, p_{t-1} is the forecasted penetration each previous year, p is the penetration the year before the introduction and HHI is the Herfindahl-Hirschman Index the year before the introduction.

The Herfindahl-Hirschman Index (HHI) is a commonly accepted measure of market concentration. It is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers.

$$HHI = \sum_{i=1}^N s_i^2 \quad \text{Eq. 3}$$

where s_i is the market share of firm i and N is the number of firms operating in the market.

HHI takes into account the relative size and distribution of the firms in a market and approaches zero when a market consists of a large number of firms of relatively equal size. HHI increases both as the number of firms in the market decreases and as the disparity in size between those firms increases, and it does so in a non-linear way. The HHI at the moment of introduction is included to measure whether it is more or less difficult to enter a more concentrated market. It is an exogenous index as it is taken at the moment just before the entry and it does not depend on the evolution of market share, in the concept of [4].

The Linear Logistic model, also known as Fisher-Pry model [10], is described as

$$Y(t) = \frac{S}{(1 + e^{-(a-b \times t)})} \quad \text{Eq. 4}$$

S represents the saturation level and a, b are parameters, describing the speed of diffusion. This diffusion model is graphically depicted by a symmetric S-curve and has an inflection point that occurs when $Y(t) = S/2$, meaning that the maximum growth rate is met when Y reaches half of its saturation level.

One disadvantage of this model is that it can be applied after a certain number of years, as it relies on a forecast for the penetration rate of each year and the estimated saturation. Meaningful results will come up only if the years since the beginning of mobile penetration in the country are enough, so

that the forecasted variables approximate the future actual values. To use the model properly in the case of Cosmote, for example, one should have an accurate prediction of these indices with only four years of actual penetration rate. In order to demonstrate the use of the model, a prediction for the case of Q-Telecom is presented. In this case, the eight years of recorded penetration are enough to present an accurate forecast with the use of the Linear Logistic model.

IV. ANALYSIS AND RESULTS

The change in HHI over the period 1996-2006 is illustrated in Fig. 2. It is obvious that the index is declining over the years and the more rapid declination is recorded in 1998. That is the year when Cosmote began its operation.

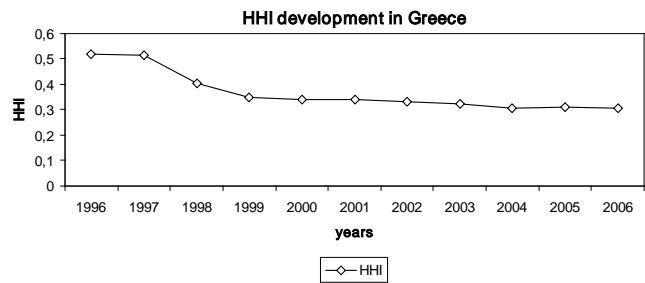


Fig. 2. HHI development in Greece

The application of the Linear Logistic model, using the recorded mobile penetration of the period 1994-2001, is illustrated in Fig. 3. Table 2 illustrates the statistical measures after the application of the diffusion model. The results reveal that the estimated S-curve fits ideally the actual data (the measure of R^2 is 0,9996, meaning that the ideal value of 1 is almost reached). The data used for the demonstration of the model are depicted in Table 3 and the illustrated results after the application of the model for Q-Telecom are presented in Figure 4. Table 3 presents annually the actual values of each operator’s subscribers, the estimation of the HHI based on the number of subscribers, the recorded penetration level of the country and the calculated values of market penetration that came up after the application of the Linear Logistic model.

The first parameter that captures the «long-run» market share is 10,3% for Q-Telecom. One fact that was not recorded by the model is that Q-Telecom began its operation in June of 2002, meaning that it only had six months to compete with a full year of the prediction. After the first year, the actual market share gradually approximates the predicted data. The actual market share of the operator results to a more-or-less stable area, revealing that it cannot reach the market share levels of the other operators in the near future. This observation is probably related to the fact that Wind realised the acquisition of Q-Telecom, leading the Greek mobile market to equilibrium between the three remaining operators. In the following years, Cosmote, Vodafone and Wind share the

number of Greek subscribers almost equally, but the battle for market dominance is still on.

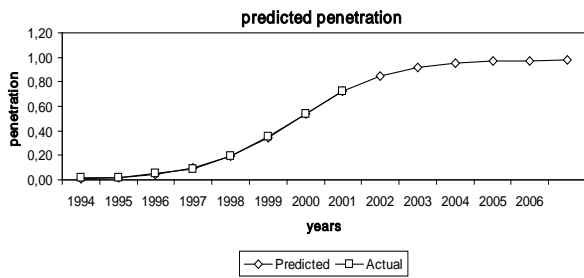


Fig. 3 Demonstration of the Linear Logistic model's prediction for Greece's mobile penetration

TABLE II
PARAMETER ESTIMATION AND STATISTICAL MEASURES OF PRECISION

S	a	b	R-squared	Ra-squared	DW statistic
0,98	-5,46	0,81	0,9996	0,9994	1,7604

TABLE III
DATA USED FOR THE APPLICATION OF THE MODEL IN THE GREEK MOBILE MARKET

Year	Vodafone	Cosmote	TIM	Q-Telecom	A.P.	P.P	HHI
1994					0,02	0,01	
1995					0,02	0,02	
1996	320.000		211000		0,05	0,05	0,521
1997	547.000		391000		0,09	0,10	0,513
1998	1.069.000	298838	668614		0,19	0,19	0,403
1999	1.663.000	1048352	1182751		0,35	0,35	0,349
2000	2.225.981	2061011	1645098		0,54	0,54	0,338
2001	2.884.872	2943532	2135338		0,72	0,72	0,339
2002	3.218.707	3506338	2513642	76000	0,83	0,84	0,333
2003	3.782.737	3917010	2402777	366536	0,95	0,91	0,324
2004	4.064.000	4151000	2323866	854436	1,04	0,95	0,307
2005	4.479.000	4644000	2419000	908000	1,13	0,96	0,311
2006	4.960.000	5217927	2831840	1072147	1,28	0,97	0,307

Source: Annual reports of Greek mobile providers
A.P.=Actual Penetration and P.P.= Predicted Penetration

TABLE IV
ANNUAL ACTUAL AND PREDICTED MARKET SHARE FOR Q-TELECOM (2002-2006)

Year	Actual Q-Telecom	Predicted Q-Telecom
2002	0,00816	0,0632
2003	0,035	0,0663
2004	0,075	0,0673
2005	0,073	0,0679
2006	0,0762	0,0682

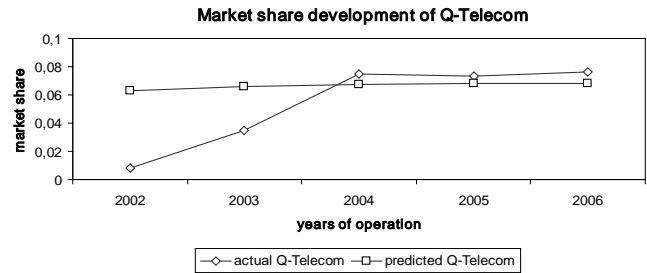


Fig. 4 Demonstration of predicted versus actual data

As observed in the predicted market share development of the operator, changes in penetration rate influence up to a major point the speed at which operators may gain market share. When many new subscribers enter the market, it is easier to attract them and increase market share than in a case where penetration rates are almost constant. Another interesting observation is that the proposed model approximates, quite accurately, the «long – run» market share of the Q-Telecom rather than the market share development during the first years of operation. This characteristic of the model should be the main focus of analysts and potential investors.

V. CONCLUSION

This paper has introduced an empirical model that predicts the later entrant's market share development in the mobile telecommunications market of a country. It can be used as a preliminary tool by the analysts of the mobile market, as well as by the potential investors interested in predicting the market's potential before the act of entry, merger or acquisition.

The evolution of market share is explained by factors such as the moment of entry, the HHI at the moment of entry and the forecasted changes in the penetration rate, as estimated by the Linear Logistic model. There is strong evidence that the earlier a new operator enters the country's market, the greater potential the operator has in gaining significant market share.

The model gives an overall idea of the market share development of a later entrant that can become more accurate if combined with other methods, which take into account other crucial variables, such as pricing, cost and profits. The most logical extension of the model is the inclusion of the pricing effect. The difficulty lays in the absence of announced price time-series data. The effect of the marketing potential of each operator would also improve the forecasting accuracy of the model, although the recording of such a value demands too much market information. Nevertheless, the predicted outcome of the model's application approximates the actual data, especially the «long – run» market share of the two operators.

In terms of competition, evidence from Greece is in accordance with Geroski, who supports that too much competition slows diffusion [11]. It would be wise to observe

the application of the model in other cases of later entrants in different countries in order to confirm its general application potential. The testing of the model in markets other than the mobile telecommunications market, which have similar characteristics, is also anticipated to provide interesting outcomes.

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