MATHEMATICAL MODELS OF DEVELOPMENT THE WORLD INFORMATION SOCIETY

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ABSTRACT

In this article we consider ways of a prediction of volume of the market of telecommunications as main indicator of development of an information society of various economic subjects. We investigate the factors influencing volume of the market of telecommunications and degree of their influence. We have constructed mathematical models and have shown that the basic significant factors of development of an information society are Technological characteristics, such as *The number of fixed mainlines per 100 inhabitants, Total telephone subscribers, Total Internet users etc.* Besides in work it is shown what to predict development of the market of telecommunications it is possible with use of index DOI developed by the International Information society. However it is necessary to remember that the small quantity of historical supervision can affect results.

Keywords: Information society, market of telecommunication, econometric models.

МАТЕМАТИЧЕСКИЕ МОДЕЛИ РАЗВИТИЯ МИРОВОГО ИНФОРМАЦИОННОГО ОБЩЕСТВА

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АННОТАЦИЯ

В этой статье рассмотрены способы предсказания объема рынка телекоммуникаций как основного индикатора развития информационного общества различных экономических субъектов, исследованы факторы, влияющие на объем рынка телекоммуникаций и степени их влияния, построены математические модели развития рынка ИКТ. В статье показано, что основные существенные факторы развития информационного общества - количество фиксированных основных линий на 100 жителей, количество абонентов, пользователей Интернета и т.д. Кроме того, в работе показано, что

прогнозировать развитие рынка телекоммуникаций можно с использованием индекса DOI разработанной Международной информационного общества. Однако надо помнить, что использование выборки малого объема для построения моделей, может повлиять на результаты.

Ключевые слова: Информационное общество, рынок телекоммуникаций, эконометрические модели.

Introduction. A series of features makes the mobile telecommunications industry an interesting field of investigation for economists: the industry is experiencing very fast market growth combined with rapid technological change; regulatory design in setting market structure is playing a very important role; and oligopolistic competition is unfolding under various forms. The number of subscribers to mobile networks is growing at a rapid rate on a worldwide basis.

During the 1990s the number of mobile subscribers worldwide increased by an annual rate of 50 per cent. An important year was 2002, when the number of world mobile subscribers for the first time exceeded the number of fixed lines. The number of mobile subscribers was close to 1.2 billion at the end of 2002, while the number of fixed lines was slightly below 1.1 billion. The year 2002 therefore established at worldwide level what had already been observed for an increasing number of countries during the previous few years: mobile telecommunications is the most widespread access tool for telecommunications services. The mobile telecommunications industry has acquired as many users in some twenty years worldwide which took the fixed line telecommunications industry more than 120 years to achieve.

The mobile telecommunications industry is one of the most rapidly growing sectors around the world. This paper offers a comprehensive economic analysis of the main determinants of growth in the industry.

Statistical standards for measuring the information Society. The Organization for Economic Cooperation and Development started developing statistical standards for information society measurement about 10 years ago, through its Working Party on Indicators for the Information Society (WPIIS). The WPIIS provides a forum for national statistical experts to share experiences and collaborate on the development of information society statistical standards. Eurostat has also been active in the area of developing standards for information society measurement, mainly through its community surveys on ICT use by households/individuals and businesses. The surveys have been running since the early 2000s and use harmonized questionnaires provided to member states to use in their national surveys. The International Telecommunication Union has been actively developing standards for measuring infrastructure and access indicators for a number of years.

There are many factors, which manipulate the telecommunication market. As will be shown in this paper, total revenue from all telecommunication services may be describe by using two group of economic variables: Country characteristics and Technological characteristics.

Data description. The econometric estimates are based on annual data and cover 140 countries that have adopted cellular telecommunications. The data set covers the entire evolution of the cellular mobile industry (1995–2013) for most countries in the world. Apart from the countries that have not adopted cellular telecommunications, this sample excludes twenty-two adopters which are mostly very small countries. In total, the sample represents 94 per cent of the world's population. The time series starts in 1995 and therefore covers many cellular markets from the first year. The data on the number of analogue and digital subscribers, the waiting list and the number of fixed mainlines are from the Database on International Statistical Activities[1]. The information about the type of system is gathered from various sources, such as the trade press (Mobile Communications and EMC), GSM MoU[2]. Macroeconomic data such as GDP and population are taken from the World Bank's World Development Indicators[3]. The data on the Country Technological characteristics of the Russian Federation are from Department of Statistic[4].

Econometric specification. The following discusses how to include the variables referring to *characteristics of technological systems* and *Country characteristics* in the econometric model of *telecommunication revenue* (Y). First, it is explained how the role of the rate of economic growth is treated. Then the effects of characteristics of technological systems are explained in more detail.

Country characteristics

The following variables are included in the regressor vector, referring to country characteristics affecting the telecommunication revenues: *Gross domestic product* (X_1) and *Total annual investment in telecom* (X_2) converted into US dollars are expected to have a positive impact on the telecommunication revenues; *Population - educated population* evaluated into per cent (X_3) and *Income per capita* (X_4) are explain growth of the market of telecommunications by increase in degree of erudition of people and increase in their incomes.

Technological characteristics

For each country, the effect of the technology development can be summarised through the following variable: *The number of fixed mainlines per 100 inhabitants* (X_5) captures the size of the fixed network and may have a positive or a negative effect, depending on whether adopters view mobile telecommunications services as a complement or a substitute for a fixed connection; *Total telephone subscribers* (X_6) is obtained by dividing the number of cellular subscribers by the total number of telephone subscribers (sum of the main telephone lines and the cellular subscribers); *Waiting list for main (fixed) lines* (X_7) measures the waiting list for a fixed line connection and captures the level of efficiency of the fixed operator, as well as the current 'excess demand' for telecommunication services; *Total Internet users* (X_8) refers

[1] http://www.unece.org/stats/stats_h.htm
[2] http://www.gsmworld.com
[3] http://www.worldbank.org
[4] http://www.gks.ru

to the number of dial-up, leased line and broadband Internet subscribers; *Telecommunication equipment (including Radio sets, Television receivers, Cable television, etc)* (X_9).

At the first stage of the model specification all variables have been included in model. Calculation of the correlation matrix is shown that there are some dependent variables. This problem has been solved by division of initial model into two following models

$$Y_i = a_0 + a_{1*} X_{1i} + a_{2*} X_{2i} + a_{3*} X_{3i} + a_{4*} X_{4i} + \varepsilon_i \quad \text{(Model 1)}$$

$$Y_i = b_0 + b_{1*} X_{5i} + b_{2*} X_{6i} + b_{3*} X_{7i} + b_{8*} X_{8i} + b_{9*} X_{9i} + \varepsilon_i \quad \text{(Model 2)}$$

Models were estimated using linear least squares. The results of the estimation of the Model 1 at empirical data for Russian Federation and Euro area are shown in the table 1. Table 2 lists the results of the estimation of the Model 2 at the Russia empirical data.

As shown in tables, F-statistics and their P-Value of the two models are significant. Estimating of the Model 1 produced a good fit of the data (R^2 near 1), but the standard errors of some coefficients are relatively high. In addition to, t-statistics and their p-values for the some independent variables, such as *Gross domestic product* and *Population - educated population* of the first model are not significant. It means that this variables need to be excluded from model.

The adjusted R^2 of the model two is near to one. T-statistic of coefficients for the second model are significant but p-value of coefficients of variables X_7 and X_9 are not significant. It means that variables have the random nature. To improve the model specification these variables it is necessary to exclude from model.

Table 1. The results of the estimation of the Model 1

i	Adj R^2	F (P-value) α = 0,05	Coefficient's t-statistic / (P-value) α = 0,05				
			Intercept	X_1	X_2	X_3	X_4
Russia	0,89	238,5 (0,04)	4,5 (0,02)	1,9 (0,06)	3,7 (0,003)	0,05 (0,48)	2,9 (0,049)
Euro area	0,91	1403,6 (0,0002)	12,8 (0,009)	0,98 (0,16)	9,5 (0,01)	5,6 (0,48)	3,02 (0,007)

Table 2. The results of the estimation of the Model 2

i	Adj R^2	F (P-value) α = 0,05	Coefficient's t-statistic / (P-value) α = 0,05					
			Intercept	X_5	X_6	X_7	X_8	X_9
Russia	0,99	2368,5 (0,0004)	7,69 (0,016)	16,50 (0,003)	7,94 (0,02)	2,4 (0,13)	5,03 (0,03)	3,09 (0,09)

The results of estimating the two models show that growth of incomes of the Russian telecommunications market and the market of Europe is refer growth of incomes per capita and investments into the telecommunication industry. Growth of gross national product and a degree of erudition of people influence size of incomes a little.

It is possible to explain incomes of the Russian market values of technical characteristics such, as the number of fixed mainlines per 100 inhabitants, Total telephone and Total Internet users. Weak influence of a variable the technical equipment in the Russian market is probably connected with the incorrect empirical data.

Models of development of the telecommunications market connect with great difficulties. On the one hand it is necessary to have available representative statistical material; on the other hand inclusion in model of a great number of variables not always allows receiving the consistant, efficient and unbiased estimators of parameters of model.

The further research of incomes of the market of telecommunication as basic indicator of development of an information society will be connected with studying of the basic indexes of the World Information Society such as DOI, ICT and others to have possibility to construct a forecasting model of development of the telecommunication industry.

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