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Price strategies of mobile operators in Russia in the conditions of the global economic recession

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Keywords: *telecommunications market; protracted recession; pricing strategies; price elasticity*

Abstract

Research background: Currently, the four major mobile communications providers dominate the Russian market. The oligopolistic structure leads to negative consequences, such as a weak stimulus for the product development or technological innovation, and the lack of incentive for the call-rate reduction. In their line of work, the mobile service providers use different price strategies. To comprehend what determines the current price level and what changes one should expect therein, we have to understand which factors influence the price of the mobile services.

Purpose of the article: The chief goal of this work is the analysis of the influence of the crisis on the price strategies of the providers, as well as the forecasting of the changes of prices for their services. As the main hypothesis, this work presents the assumption that during the recession the price of the mobile services in the different regions of Russia will grow.
Methods: The authors built regression models for the dependence of the average price of the mobile providers' services in a particular region from the selected factors. In this work, we selected the following types of the multiple regression equation as the modeling functions: linear, power-law, exponential. Adding the time factor (t) is the key element of the forecasting.
Findings & Value added: After gathering the data and the subsequent calculation of the medium price baskets, we were able to build different multiple regression models. To build the forecasts for the dynamics of prices in the regions for the year 2018 we selected the best regression models. The analysis of the acquired forecasting results generally proved our hypothesis about the growth of the average prices for the mobile communications services, expected in 2018 in the majority of regions. The analysis itself, the programs created for its implementation, as well as the results obtained, can, in our opinion, be considered as some contribution to the development of the theory of price competition in oligopolistic markets. The mobile services' markets in many EU countries have a similar structure, and, with this in mind, the results of forecasting price dynamics obtained from Russian experience may be of interest to scholars dealing with similar problems in their respective countries, including the possibility of conducting comparative studies.

Introduction

In the Russian economy, the telecommunication industry is currently a sizeable and important sector, a "growth area" in the situation of the prolonged economic recession. According to the data of Rosstat, the services provided by the industry in 2016 totaled 1.7 trillion rubles, which constituted nearly 3% of the GDP of Russia. The main segment of the industry is the market of mobile communications, rapidly developing throughout the recent years. Its subscriber base, which is the number of SIM-card holders, is growing, and as of the end of 2015, the mobile penetration level in Russia reached 190% (Russian Federal State Statistics Service, 2016).

This research is the continuation of the authors' long monitoring and analysis of the telecommunications market in Russia. The first studies were devoted to the analysis of the credit risks that the telecommunication companies of Russia had encountered in 2006–2007, right before the previous crisis of 2008–2009, which significantly altered the structure of the mobile services market in Russia. At that time, this market included a considerable number of independent companies, and the structure of the market itself bespoke a monopolistic competition. The crisis, however, led to complete disappearance of some companies, consolidation of the others, and takeover of still other companies by their stronger competitors. The reasons for such a drastic market share reallocation included for the telecommunication market, as in fact for any other, the problems of financial instability of the companies, as well as unjustified credit risks (Dengov & Tulyakova, 2015,

pp. 123–130, pp. 131–138, pp. 139–146). The later studies the authors carried out in the period preceding the second wave of the crisis that started in mid-2014. By that time, the Russian telecommunication market clearly showed all signs of an oligopolistic structure. Currently, the four major mobile communications providers still dominate the Russian market (MTS, Megafon, Beeline, TELE2). The high barriers (of mostly natural character) seriously hamper the access of any new providers. Our calculations of the HHI resulted in 2449, which speaks of a very high degree of market concentration (Dengov *et al.*, 2017, pp. 329–337). Such a situation opened the door for the restriction of the competition and price discrimination. At this stage, our analysis concentrated on the price aspect, since the price for the mobile services is a chief factor in the telephone subscriber's decision-making in his choice of a particular company (Tulyakova *et al.*, 2017, pp. 2730–2737).

In their line of work, the mobile service providers use different price strategies. So, to comprehend what determines the current price level, and what changes one should expect therein, you have to understand which factors (and to what extent) influence the price of the mobile services, offered by the providers.

Among the external circumstances, influencing the pricing process in the market of the mobile services, one should take into the account the prolonged recession in which the Russian economy finds itself ever since 2014. Of course, the recession itself clearly has a varied influence on the different sectors of the economy. For the companies, the lack of smart target and price strategy during a crisis means a serious risk of bankruptcy (Kliestik *et al.*, 2018, pp. 791–803).

The chief goal of this work is the analysis of the influence of the crisis on the price strategies of the major mobile service providers, as well as the forecasting of the changes of prices for the services, provided by the mobile operators, on the condition of maximum profit.

As the main hypothesis, this work presents the assumption that during the recession the price of the mobile services in different regions of Russia will grow. However, the actual amount of change will be different depending on the region. The specific price strategy of the mobile service providers will depend on the extent of the influence of crisis on the economy of a particular region.

The paper has the following structure. The next section provides an overview of the research on telecommunication markets' structure in various countries, its impact on the levels of industry competition and the pricing strategies of major providers. Then, the research methodology is explained, in particular the specific features of data selection for subsequent

analysis, the methodology of their processing, and the principles of constructing and using multivariate regression models. After that, our empirical study's results are described, and the possibilities of the constructed models' further use are discussed, taking into consideration the identified limitations. Finally, we formulate the research's general conclusions.

Literature review

According to international research, a successful development of the telecommunication industry significantly influences the GDP of almost any country (Duncombe, 2016, pp. 213–235; Lee *et al.*, 2012, pp. 461–469; Sridhar & Sridhar, 2007, pp. 37–56; Waverman *et al.*, 2005, pp. 10–24). The oligopolistic structure of the telecommunication market leads to negative consequences, such as a weak stimulus for the product development or technological innovation, and the lack of incentive for the call-rate reduction. From the research of the telecommunication markets development in other countries, one can see that such problems have an international character. Slovakia, for example, by this time demonstrates a case of classic quadropoly (HHI (2017) — 3272), and the problem of barriers is quite urgent for the new players, wishing to enter the industry (Valaskova *et al.*, 2019, pp. 49–64). The high degree of concentration in the industry significantly influences the level of competition (Madlenakova *et al.*, 2018, pp. 413–421; Corejova *et al.*, 2016, pp. 1653–1656; Kintler, 2013, pp. 241–245). The influence of the oligopolistic structure of the market on the investment process in the industry is ambiguous (Cave, 2006, pp. 223–237). This kind of research is common also for the telecommunication markets of other countries — Serbia (Kosti´c *et al.*, 2016, pp. 323–343), Poland (Sznajd-Weron *et al.*, 2008), Spain (Hurkens & López, 2012, pp. 369–381), Italy (Valletti, 2003, pp. 47–65), Senegal (Ndiaye & Thiaw, 2011, pp. 6651–6656), etc.

The telecommunication industry in Russia is currently actively growing and developing. Beresneva (2017, pp. 240–256) emphasizes that the service that ensures the main growth of the subscriber base and the demand for the communication services is the mobile Internet, for instance, in 2017 the monthly mobile internet demographic constituted 114.8 million users, 9% more than in 2016. In the end of 2016, the providers widened the high bit rate LTE coverage outside of the large cities, which increased the average Internet speed for the country by 30%.

Spitsyn (2016, pp. 22–28), using the statistical data, demonstrates that the mobile communications segment shows the growth of income and op-

erating revenues, and specifies that the gross income of the major mobile service providers in Russia is comparable to those in Germany, Italy and Great Britain. It shows that the rates of development and the current state of the mobile communications market in Russia are close to those of some of the more advanced economies. The market also retains a positive tendency for growth of the subscriber base and the providers' profits, positively influenced by the actively spreading LTE networks and the growing digitalization of the society. Some recession is notable only in 2013–2014, most likely due to the overall crisis.

For the more precise comparison of the prices for the mobile providers' services in Russia and Western Europe, the authors analyzed the data for the markets in Russia and the UK. The analysis included the comparison of the average mobile service rated and the average wages in some of the most common industrial jobs. By taking into the account that the price of the mobile services in Europe is almost the same, and the standard of wages is comparable, one can assume that the results of such an analysis with the great probability would be very close for other countries of Western Europe as well.

The calculation was based on the average rate. In Russia, such a rate for the common needs costed 323 rubles per person per month, while in the UK it costed 840 rubles per person per month. The table 1 shows that though the nominal price of the mobile services in Russia is cheaper, in view of the average monthly wages for the majority of the jobs it is actually more expensive. As justly emphasized by Larichkina (2015, pp. 473–477), the Russian mobile communications market is at approximately at the same level as the Western one, and in some areas even surpasses it. For example, the price for one minute of mobile conversation in Russia is one of the cheapest in the world. However, the duration of call is also fairly low, the fact that the mobile service providers try to remedy, stimulating the subscribers to the lengthier conversations by the competitive rates. This tendency on the part of the providers is quite understandable, since the growth of the average length of call means the increase of the operating revenues and, therefore, the increase of the providers' profits.

So, the structure of the Russian mobile communications market by now reached the state of a hardline quadropoly. One should note though that despite such a situation, the present time shows an active emergence of the mobile virtual network's operators, which use the infrastructure of the other providers, but offer their own mobile services under their own brand. The biggest and most prominent provider of this kind is YOTA. These new players may promote the competition by offering the competitive rates and thus enticing the customers away from the major providers. It is also note-

worthy that the mobile communications market has some distinctive particularities that one needs to take into the account, when analyzing this industry. The major mobile network operators are presently entering into all kinds of telecommunications business. For example, they offer their services as the residential broadband Internet access providers.

Striving to increase their market share, the mobile service providers are actively using various price strategies. In fact, more often than not, they would have a number of different price strategies to entice the customers, yet usually they make a specific emphasis on one particular strategy. Thus, Baranova *et al.* (2015, pp. 93–95) argue that the MTS predominantly implements the price leadership strategy, Beeline relies on the individual cost pricing, while Megafon and TELE2 are more likely to use the lowest service prices policy. In our article from 2017 (Dengov *et al.*, 2017, pp. 329–337), we concluded that TELE2 emphasizes the "easy penetration" strategy, and Beeline uses the medium price strategy, striving to keep an average level of prices for their services in the majority of regions. The pricing policy of Megafon, on the other hand, shows a significant price difference from one region to another, due to their strategy of developing affiliate companies within the regions, which enjoy a certain level of independence in the determination of prices. The MTS Company, which controls the largest share (31%) of the mobile communications market of the Russian Federation (RF), carries out a typical "price leadership" police. At the same time, the strategy of the price differentiation strategy for different constituent territories of the RF ("according to the geographical market segments") is common for all the providers.

The analysis of the influence of the 2009–2010 crisis on the telecommunication industry and the companies themselves showed that in comparison to other sectors of the economy, this industry appears to be the most stable (Semenov, 2011, pp. 125–129). It leads to the conclusion that the services of the mobile communication providers are rapidly becoming a primary commodity with low price elasticity. However, from one crisis alone one cannot conclude that a new crises will never affect the mobile communications market. For the better understanding of the picture as a whole, one should also study the influence of the crisis of 2013 on the telecommunication industry. Shcherbina (2016, pp. 40–43), for instance, points out that in 2013 only the MTS and VimpelCom companies (Beeline) fulfilled the "golden rule of economy": "the growth rate of the of the total assets should be higher than the growth rate of the operating revenue, while that in its turn should be higher than the growth rate of the balance sheet profit". In general, though, the conclusion that the crisis influenced the telecommunication industry to a lesser extent than the other ones was still

true. Many of the figures continued to grow even despite the crisis, yet one could note the lowering of the gross adds number and the increase of the denials for non-payment. The providers are still interested in the growth based on the increasing quality of the provided services, implementation of the innovative technologies and effective marketing. Apart from that, they also need a smart strategy that grant them success in the competition.

Research methodology

To fulfil the goal of the research and solve the specific problems the authors built regression models for the dependence of the average price of the mobile providers' services in a particular region from the selected factors. In this work, we selected the following types of the multiple regression equation as the modeling functions:

1. Linear regression

$$y = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + \varepsilon \tag{1}$$

2. Power-law

$$y = b_0 x_1^{b_1} x_2^{b_2} x_3^{b_3} \varepsilon \tag{2}$$

3. Exponential

$$y = e^{b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + \varepsilon} \tag{3}$$

As you know, while forecasting via the multiple regression model, one is supposed to determine the consistent patterns and dependences from the past. Adding the important time factor (t) is the key element of the forecasting. It is also important to evaluate the "quality" of the model. The most usual way of primary evaluation uses the R^2 criterion ($0 \leq R^2 \leq 1$). The closer is the index to one; the better is the quality of the model. In some cases, the researchers also use an adjusted R^2. The second way of testing is the evaluation of the F criterion that shows the significance of the model. It is worth noting that the forecasting within this research was different, primarily, because the time variable had low significance. The model described primarily the change of the price according to the influence of the crisis on the price comprising factors. It is also worth emphasizing that the authors needed to build several regression models. Different models may show different approximation to the initial data. To choose an optimal function,

that is, the one that would give the truest result for the forecasting, the researchers often evaluate the sum-squared error (Q^2) to sift out the "defective" multiple regressions.

In order to create a model of good quality, it is necessary to evaluate the prime cost for the price of the mobile operators' services correctly. Naturally, the factors that the price consists of significantly influence the price of the provided services, since the providers strive to get a maximal profit. Shpagina (2009, pp. 115–118) offers a new way of calculating the prime cost for the services of a mobile communications company. The main problem, in her opinion, lies in the mistakes in the calculation of the prime cost of a particular mobile communications product, which leads to the mistakes in the management decision-making and, as a result, to the loss of profit. She thinks that rather than one universal method for the calculation of the prime cost, one needs a system of methods, each of which takes into the account the particular characteristics of a specific product. As the basis, she suggests the activity-based costing method, or the so-called ABC-method. This method allows one to evaluate the prime cost of any product of the company more precisely, since the costs of the company are calculated as the set of true costs of each particular business operation, carried out by the company. This method also presupposes the conversion of the overhead costs into the direct ones. The ABC-method is effective in a situation when the indirect costs of the company exceed the direct ones, which is true for the mobile communications companies. The implementation of this method gave us an opportunity to calculate an approximate share of the prime cost in the market price of the mobile services. It turned out that the prime costs of the mobile communications are far lower than their market prices, without doubt due to the high level of concentration in the Russian telecommunications market. The emergence of the fourth major player (TELE2), as well as several mobile virtual network operators, may significantly influence the pricing process within the market.

Kukharenko and Borovsky (2017, pp. 28–32) study the factors that the operators must take into the account when determining the prices for their services. They divide them into the external and intra-industry ones. The main intra-industry factors, in their opinion, are the quality of services, the irregularity of the traffic incidences, the market originality, the mobility of the production process, the service level on the stages of sales and subsequent customer care, the promotion strategy and the image of the company. After the marketing research, they created the matrix of the quality standards, in which they described the dependence of the quality of the service on the demands towards it. In calculating the matrix, they also took into the account the additional sales costs of the providers. As a result, they con-

cluded that this method of evaluation can be useful for the more precise pricing of the service rates, based on the surveys of the subscribers, thus allowing the providers to offer the individual price plans, which will make them more attractive to their customers.

The important elements for the building of the multiple regression models are the factors that the price consists of as well as the resultant vector of the price values for several years. We would like to point out that, for the purposes of this research, we used the data for the period from 2013 to 2017, and the final list included 80 regions. Unfortunately, the official statistic digest "The Regions of Russia" lacks the data on the necessary factors for the year 2018.

For the resultant vector of the price values, we gathered and calculated the data on the prices for the services of the mobile communications providers in each of the 80 regions. In doing that, we used the methodology of the *ComNews*[1]. The method that they use is called "the calculation of the cost of the common set of services". The OECD also actively uses this method for the calculation and comparison of prices for the mobile communication services in its member-countries[2].

The method is based on the assumption that the subscribers use a particular set of services each month (the so-called "consumer basket"), that is — make a particular number of calls, send a particular number of messages, and use the Internet. Thus, the "consumer basket" includes the set of services that one subscriber uses within a month. However, the actual set of services is different for each subscriber, and nobody can count each subscriber one by one, so the research operates on the average values of the set of services used by one subscriber each month. Since some subscribers are more active, while others barely use the mobile communications services and even call someone very rarely, all subscribers, according to this chosen method, are divided into three groups: the ones with low activity — they use up the "small basket", the ones with medium activity and, thus, the "medium basket", and the most active subscribers with the "expensive basket". Originally, the OECD uses six price baskets (from "30 call basket" to "900 call basket" and "400 messages basket"), but the *ComNews* considers it more appropriate to use only three.

Without lengthy explanations, let us mention only that in our research we calculated only the data for the medium price basket, characteristic to the majority of the population in Russia. We took the data on the consump-

[1] *ComNews* annually calculates and compares prices for mobile services in the corporate and private sectors: https://www.comnews.ru/sites/default/files/comnews_group_presentation_2018_rus.pdf

[2] http://www.oecd.org/sti/broadband/48242089.pdf

tion volume for the mobile communications services and the breakdown of the outgoing calls by length and areas from the report of the *ComNews*.

For the evaluation of the cost of the "medium basket" in each region, we selected the most budget-friendly rates, covering the set of services consumed by a subscriber. The calculations included only the "Big four" service providers, since practically they are the only ones, who provide their services in all the 80 regions. We studied both the post-paid "pay-as-you-go" rates without the subscription fee and the pre-paid ones, where the user pays a certain fee for the specific set (package) of services.

Thus, we took the specific (most economic) rate for each provider and used it for the calculation of the cost of the mobile communications services in each region. It is worth noting that starting with 2015 there has been a pronounced tendency towards the growth of the number of the pre-paid plans and their favorable prices. Thus, from 2015 onward, we used only the pre-paid rates with a subscription fee.

After the calculation of the cost for each of the providers within the region, we proceeded to the calculation of the average value for the region.

The formula, used for the calculation of the cost of the post-paid rate is as follows (4)[3]:

$$Sum_{ij} = 17 * \left(ctf_{ij} + ctn_{ij}\right) + 9 * ci_{ij} + 57 * \left(ccf_{ij} + ccn_{ij}\right) + 29 * (cdf_{ij} + cdn_{ij} + 9 * cv_{ij} + 50 * sms_{ij} + 9 * mms_{ij} + 8 * int_{ij} + o_{ij}) \quad (4)$$

where:
$i \in [1;80]$ – the region in which the price basket is calculated;
$j \in [1;4]$ – the operator for which the price basket is calculated;
Sum_{ij} – price of the postpaid tariff;
ctf_{ij} – price of the first minute to the city phone number;
ctn_{ij} – price minutes to the landline phone number;
ci_{ij} – price of one minute of long-distance call to the same operator;
ccf_{ij} – price of the first minute of calling to the telephone within the network,
ccn_{ij} – price for the next minutes of calling to the telephone within the network;
cdf_{ij} – price of the first minute of calling to the telephone of another operator in the home region;
cdn_{ij} – price for the next minutes of calling to the telephone of another operator in the home region;
cv_{ij} – price of one minute of the call to voice mail;
sms_{ij} – price of one SMS message to the phone of the same operator;
mms_{ij} – price of one MMS message to the phone of the same operator;

[3] The coefficients in the formula for the total cost of the postpaid tariff (17, 9, 57, etc.) were taken from *ComNews* yearbooks (for 2013–2014 and other years).

int_{ij} – price of one used megabyte of mobile Internet in the home region;
o_{ij} – price of other additional services or packages provided.

The formula, used for the calculation of the cost of the pre-paid rate is as follows (5):

$$Rez_{ij} = cp_{ij} + co_{ij} \tag{5}$$

where:
Rez_{ij} – the price of the prepaid tariff;
cp_{ij} – price of the set of services;
co_{ij} – price above the set of services.

To calculate further the cost of the average basket for the region, the formula was used (6):

$$MRV_i = \frac{\sum_{j=1}^{n_i}(Sum_{ij}+Rez_{ij})}{n_i} \tag{6}$$

where:
n_i – the number of operators in the region in which the price basket is calculated;
Sum_{ij} + Rez_{ij} – the cost of a prepaid or postpaid tariff (one of two takes a value equal to 0).

Using this methodology allowed us to analyze the five-year dynamics of the average monthly fee for cellular mobile services in all regions, to determine the place and role of each operator from the "Big Four" in each region, and to break down all regions into groups and allocate from them 15 regions with the lowest and 15 — with the highest payment of mobile services.

The conclusion of this stage of the analysis provided us with the resultant vectors of price for each of the operators, necessary for the building of the multiple regression models.

We used the least-squares technique to determine multiple linear regression coefficients. We would like to mention that to make both the exponential and power-law functions valid for this case, we had to take a logarithm of the initial values of some of the coefficients and then take the exponent of all values (in the case of the exponential model) or of the first resultant value (in the case of the power-law model).

Let us shortly describe the method of the calculations. Let us assume that we have the set of factors and resultant values for a certain number *l* of years:

$$(x_i; y_i), i \in 1, \dots l, x_i \in R^m, y_i \in R \tag{7}$$

where:
x_i – the number of factors taken into account in the model that belong to the space R^m;
y_i – the number of results (outcomes) that belong to the space R.

In that case, we can formulate our task as the one of building of such a bijective map that for each $x \in X \rightarrow y \in Y$. With this condition for the building of the model, the function $y = f(x)$ will look as follows:

$$y = \beta_0 + \sum_{j=1}^{m} \beta_i x_i \tag{8}$$

Then we need to set the quality function, which assumes the following form:

$$Q(X, \beta) = \frac{1}{2} \sum_{i=1}^{l} (y_i - (\beta_0 + \sum_{j=1}^{m} \beta_j x_j))^2 \tag{9}$$

in this case, if:

$$F = \begin{pmatrix} 1 & x_1^1 & \dots & x_1^m \\ 1 & x_2^1 & \dots & x_1^m \\ \dots & \dots & \dots & \dots \\ 1 & x_l^1 & \dots & x_l^m \end{pmatrix} \tag{11}$$

and at the same time:

$$y' = \begin{pmatrix} y^1 \\ y^2 \\ y^3 \\ y^4 \end{pmatrix} \tag{11}$$

then the vector $\boldsymbol{\beta}$, which will minimize the function Q and will be optimal, and it will be found from the equation:

$$\frac{\partial Q}{\partial \beta} = 0 \tag{12}$$

$$F^T(F\beta - y') = 0 \tag{13}$$

$$\beta_{opt} = (F^T F)^{-1} F^T y' \tag{14}$$

where:
$\beta_{opt} = (\beta_1, \dots, \beta_l)$

We had to perform all those operations with the matrix of coefficients and the resultant vector of each region thrice, since in our work we were building three regression models. Let us mention several important conditions for the building. Firstly, the number of factors must be necessarily less than the number of years. That is, for the work using a 5-year period (2013–2017), the number of factors should not exceed four. It is also very important that the factors themselves should be related to the mobile communications market and susceptible to crisis. By that, we mean, in this case, that the selected data that would become the basis for the coefficient matrix should show changes if the region encounters a crisis.

In our analysis, we used the following factors as the coefficients xi: 1) the fixed capital investments per head of the population; 2) the per capita population income; 3) the volume of the communications services per head.

Results

Now, let us look at the acquired results and analyze them. Fig. 1 shows the change of the average monthly payments for the mobile communication services for all the regions (without the division by the specific provider).

As evident from the diagram (See Figure 1), the average cost of the services lowered year by year, at the same time the volume of the provided services grew. It is especially evident in the increase of the provided Internet traffic. The significant lowering of the price is largely caused by the growth of the number of the regions, where TELE2 began to provide its services within the period from 2014 to 2016 (from 40 to 62). At the same time, it is also evident from Fig. 2 that year-by-year this mobile operator has consistently provided its services for the lowest average price. We would also like to point out that in 2017 the average prices for the services of such providers as MTS, TELE2 and Beeline have nearly equalized, while the price for the services of Megafon has conversely grown. One may also notice that the pricing leaders constantly change depending on the year and the region. Thus, for instance, in 2013 MTS had been the most expensive provider in the majority of the regions, while in 2016 it was already Beeline. With regards to different rates, it is necessary to point out that if for the post-paid rates the thing that changed from region to region was the

price of the services (that is one minute of call, one SMS or 1Gb of Internet traffic could become cheaper or more expensive), then for the pre-paid ones in the majority of cases it was not the price that changed, but rather the volume of the services included into the "package" provided for the specific subscription fee.

The calculations allowed us to single out the 15 regions with the lowest, as well as the 15 regions with the highest prices for the set of the mobile communications services within the period of 2014 to 2017[4], and the acquired body of data led us to several conclusions. Firstly, the rating of the regions with the lowest service prices undergoes significant changes each year. At the same time, some regions (though very few) consistently remain on the list of the cheapest. In view of this circumstance, one may conclude that the providers have been lowering the prices in all of the regions, but hardly according to any plan. In fact, it rather resembles the dynamic response to the change of the economic situation and the activity of the competitors. Speaking about the list of the 15 cheapest regions, both the lower (from 259 rubles in 2014 to 227 rubles in 2017) and the upper borders of the prices of the mobile services gradually decrease.

Analyzing the rating of the 15 most expensive regions, we noted that several regions consistently stay on this list (Chukotka, Magadan region, etc.). At the same time, the lowering of the upper border of prices of the mobile communications services for the list of top-15 was more drastic (from 776 rubles in 2014 to 397 rubles in 2017, that is nearly by half) compared to the list of the cheapest regions.

The year-by-year analysis of a number of regions where a specific provider of the "Big four" offered the clients the best-price rates, showed that the competition among the providers had been pretty fierce, which proves the lack of the price-fixing conspiracy among them (See Figure 3).

If in 2014 the leaders thereof were Megafon (30 region) and TELE2 (21 region, even despite their presence in only 40 regions out of 80), then in 2017 the above-mentioned providers promptly lost their leadership, and MTS and Beeline overtook the leading positions.

For further building of the models, the authors needed to know the changes of each of the factors in the year of the crisis. Having performed this task for each region, we acquired the set of values for the forecast. Let us note that for the determination of the optimal multiple regression model we used the coefficient of squared difference of errors. However, the analysis of such a criterion as R^2 has also proved to be significant.

[4] Due to the large body of acquired data, the authors decided not to include the corresponding tables, however, they are ready to provide them upon demand.

One of the authors, for the purposes of this research, wrote a program that computerizes the formerly described process of building three different models for each region. The program also calculates the coefficient of squared difference of errors Q^2 to determine, the results of which model are the closest to the initial data. Then, for that optimal model, we calculated the R^2 coefficient to understand the significance of this model and to establish the quality of the future projection model. It is necessary to mention at once that the values acquired in the course of building of the multiple regression models differed not only from the initial data, but also from each other.

After that, we needed to select the model that provided the closest result to the initial data. Then we had no reason to evaluate the other two models, much less to build the forecast upon their results. That is the reason for the calculation of the squared difference of errors for each of the models, in order to choose only one of them.

The program also provides the drawing of all of the models. As an example, let us examine the results of the analysis for the Amur region (See Figure 4). In the lower part of the diagram, we see that the best Q^2 coefficient is one for the power-law model. Its value itself is small enough and constitutes 0.047. Then let us look at the R^2 coefficient. For this multiple regression model, it equals 0.6452. This shows us that this model has a fairly good, at least acceptable value. Now let us proceed to the analysis of the coefficients of the established function. The value of the coefficient for the capital investments into the Amur region is positive, while the values for both the volume of provided communications services and the per capita population income are negative. It means that the increase of the investments into this region would lead to the growth of price of the mobile communications services. At the same time, it means that the increase of the volume of the communications services would lead to the lowering of prices. As well, the decrease of the population income would cause the increase of the price, for which the operators would be ready to provide the mobile communication services.

Discussion and limitations of study

We should mention here that the analysis of the results of the program for all the regions showed that we could not build a good model for every single one of them (for example, in the Belgorod and Kaluga regions). Even though we had been building three models, in some of the regions none of

them showed the results close enough to the initial data. Clearly, the forecast built upon such models would not be very interesting.

We found a particular interest in the analysis of the models that were not too far from the initial data, but neither as close as the one for the Amur region. We are talking about the territories, the coefficient of the squared difference of errors for the models of which was not as big (for instance, the Vladimir and Bryansk regions).

Despite the above-mentioned circumstances, we performed the forecasting for all 80 regions. However, it is clear that the proof or disproof of the assumed hypothesis, based on these kinds of models for some of the regions could have been not sufficiently correct.

The coefficient of the squared difference of errors for the selection of the best multiple regression model for each regions was calculated according to the following formula:

$$Q^2 = \sum_{i=1}^{n} (Y_i - Y_i')^2 \tag{15}$$

where:
$i \in [1;5]$ – year, the results of which are compared,
Y_i – known average price in the region,
Y_i' – the price in the region as a result of matrix transformations for one of the three multiple regression functions.

We calculated that criterion for each of the 80 regions and each of the three functions. Then we compared the values of that criterion and selected those models, for which it was the smallest, as the ones for the future forecasting.

After the selection of the optimal regression model, we added to the matrix of factors per years one more line with values originally for 2017 but altered by the generalized crisis influence. In this way, we created an additional "year", described in the graphs as 2018, for which we actually made a price forecast by using the function.

We carried out the analysis of the resulting forecasts for all the 80 regions. Due to the limited space, let us show just a few examples. In Fig. 5, you can see the graph of the forecast for one of the regions with the highest projected price, namely, Moscow and the Moscow region. (The green line in the graph shows the result of the actual data representation, the red one — the result of the selected function, in this case — the power-law function).

The graph shows that this region, as well as, for instance, Smolensk region, or Krasnoyarsk and Perm territories (all of them from the top-15 list), according to the forecast, will remain among the most expensive regions, where the price for the mobile services in the case of crisis may reach up to almost 900 rubles.

With regard to the regions with the lowest price for the mobile communications services as of 2017, let us examine the forecast for the Sverdlovsk region (in this case, the red line represents the result of the linear function, selected as the best one) (See Figure 6).

This region, as well as some others from the list of the 15 "cheapest" regions, according to the forecast should also remain in that list. According to the prognosis, the price of the mobile communications services in these regions should lower even further (down to 90 rubles, for instance, for the Krasnodar territory).

The further analysis showed that the average price in the regions in the case of crisis should constitute 375 rubles. We should also point out the wide spread between the lowest and the highest values, which could constitute more than 800 rubles. At the same time, the departure of the maximal price from the average level is also quite big — 538 rubles, while the difference between the minimal value from the average price is only 285 rubles.

Unfortunately, the value of Q^2 in the graphs for some of the regions is too big, which means that even the best model deviates too far from the initial data, and the results of the forecasting are not sufficiently precise. On the other hand, there are multiple examples, where Q^2 is small enough and the regression graph nearly conforms to the initial data, thus, the forecast for such a region will show much more precision. To increase the precision, one would need either the larger scope of years, or the bigger number of factors, ideally — both.

According to the comparative analysis, the forecasted growth of price for the "medium basket" of services will not occur in every single one of the regions. Quite the opposite, a big number of regions may expect the lowering of prices. Obviously, the providers will make different decisions on the change of prices depending on the region.

In view of the above-described circumstances, in order to prove the initial hypothesis of the general growth of prices for the mobile communications services in the situation of prolonged recession, yet with the possibility of their lowering in specific regions correctly, we had to select the graphs with the best quality. By this, we mean the graphs for the regions with the lowest Q^2, namely, Q^2 is less than 1. We found five such regions (Tyumen, Amur and Murmansk regions, the Mari El Republic, and the

Khanty-Mansi Autonomous Area). The graphs for these regions pass maximally close to the initial data. The analysis of the R^2 coefficient for the selected regions also proves the sufficient quality of these models. None of the above-listed territories has the R^2 higher than 0.8, they all fall within the range from 0.6 to 0.8.

Judging by the graphs of all these regions, we can expect the growth of the prices for the mobile operators' services. Our assumption that the change of price for each region may be different also proved to be right. The explanation of such a behavior of the major operators lies in the fact that we are dealing with an oligopolistic market and the mobile communication services are rapidly moving into the "primary commodity" category.

Concluding the discussion of the analysis' results, it is worth noting that a rather limited number of factors taken into account (only three) seems to have become a real limitation that did not allow to obtain more reliable results for a significant number of regions. It is obvious that if more factors were to be included in the program, the model would be more adequate, and the forecast — more accurate.

Conclusions

The analysis that we performed brought us to the following general conclusions:

1. Despite the prolonged recession in the Russian economy as a whole, the telecommunication industry continues to be one of its most stable sectors, and even more than that, it may be considered as one of the driving forces for the resolution of the crisis.
2. The comparison of prices for the mobile communications services in Russia and the United Kingdom showed that even though the nominal prices for the communication services in Russia are lower, in view of the average monthly wages, the communications in Russia cost more than those in the UK, and, come to that, the other European countries as well. At the same time, the operating profits of the major Russia mobile communications providers are comparable to those in Germany, Italy and the Great Britain, which means that with regard to the level of development and the growth rate the Russian mobile communication market is on par with those of the more developed economies.
3. The analysis of the dynamics of the average for all the providers "medium basket" of services showed that it had been gradually lowering in general for all the regions up to 2017. The reason for it lay in the growing penetration of TELE2, the fourth major player in this market, tradi-

tionally differentiating itself from its competitors by the lower prices, into new regions. The other players had to lower their prices as well. As a result, in 2017, TELE2 had even lost its leadership in the number of regions where they offered their services for the lowest price possible. That led us to the conclusion that in 2013 to 2017 the market experienced a period of fierce competition with clear signs of the lack of the price-fixing conspiracy.

4. After gathering the data and the subsequent calculation of the medium price baskets, we were able to build different multiple regression models. They relied on such factors as the fixed capital investments per head of the population, the per capita population income and volume of the communications services per head. To build the forecasts for the dynamics of prices in the regions for the year 2018 we selected the best regression models. In the process, we determined that even the selected models could not provide a precise forecast for all of the regions. Therefore, even though we made the forecasting calculations for all the 80 regions of the Russian Federation, in our analysis we emphasized those regions, for which we could get the more correct models.
5. The analysis of the acquired forecasting results generally proved our hypothesis about the growth of the average prices for the mobile communications services, expected in 2018 in the majority of regions. At the same time, in some regions, one could expect the lowering of the prices for the "medium basket". Until now, the official sources lack the information on the actual dynamic of this index in the regions in 2018. We are waiting to compare it with our prognosis. In the event that the actual results in most regions are close to our forecasts, it will be possible to continue work on improving our program, in particular by expanding the number of factors included in the analysis.
6. Given the international character of our authors' team, the next concrete step may be to use our improved program to predict the dynamics of price changes by mobile operators, first in Slovakia and then possibly in other countries of the Visegrad Group.

References

Baranova, I., Kud, A., & Kaliuzhnaia, K. (2015). Mobile services market. *Simvol nauki, 6*.

Beresneva, T. (2017). Telecommunications industry in Russia: state and development prospects. *Modern Science: Current Issues and Development Prospects, I.*

Cave, M. (2006). Encouraging infrastructure competition via the ladder of investment. *Telecommunications Policy, 30*(3-4). doi: 10.1016/j.telpol.2005.09.001.

Corejova, T., Sedlakova, I., & Sedlakova, E. (2016). Analysis of electronic communication market in Slovak Republic by revenues in 2004–2012 years. *Autobusy: Technika, Eksploatacja, Systemy Transportowe, 6*.

Dengov, V., & Tulyakova, I. (2015). Credit risk analysis for the telecommunication companies of Russia: problem statement and selection of indicators. In *2nd international multidisciplinary scientific conference on social sciences and arts (SGEM 2015).* Albena: Bulgarian Academy of sciences. doi: 10.5593/SGEMSOCIAL2015/B22/S6.017.

Dengov, V., & Tulyakova, I. (2015). Credit risk analysis for the telecommunication companies of Russia: statistical model. In *2nd international multidisciplinary scientific conference on social sciences and arts (SGEM 2015).* Albena: Bulgarian Academy of sciences. doi: 10.5593/SGEMSOCIAL 2015/B22/S6.018.

Dengov, V., & Tulyakova, I. (2015). Credit risk analysis for the telecommunication companies of Russia: fuzzy model. Comparison of the results. In *2nd international multidisciplinary scientific conference on social sciences and arts (SGEM 2015).* Albena: Bulgarian Academy of sciences. doi: 10.5593/SGEMSOCIAL2015/B22/S6.016.

Dengov, V., Tulyakova, I., & Shkorova, K. (2017). Globalization and the telecommunication market of Russia: structure and pricing policy. In T. Kliestik (Ed.). *Proceedings of the 17th international scientific conference on globalization and its socio-economics consequences.* Rajecke Teplice: University of Zilina.

Duncombe, R. (2016). Mobile phones for agricultural and rural development: a literature review and suggestions for future research. *European Journal of Development Research, 28*. doi: 10.1057/ejdr.2014.60.

Hurkens, S., & López, Á. L. (2012). The welfare effects of mobile termination rate regulation in asymmetric oligopolies: the case of Spain. *Telecommunications Policy, 36*(5). doi: 10.1016/j.telpol.2011.11.008.

Kintler, J. (2013). Mobile operators telecommunication market regulation in Slovakia and European Union. In S. Majtan (Ed.). *Proceedings of the conference on current problems of the corporate sector location. Aktualne problemy podnikovej sfery 2013*. Bratislava: EKONÓM.

Kliestik, T., Misankova, M., Valaskova, K., & Svabova, L. (2018). Bankruptcy prevention: new effort to reflect on legal and social changes. *Science & Engineering Ethics, 24*(2). doi: 10.1007/s11948-017-9912-4.

Kosti´c, Z., Stojanovi´c, B., & Raduki´c, Sn. (2016). Measuring the level of competition on the Serbian mobile telecommunications market. *Economic Themes, 54*. doi: 10.1515/ethemes-2016-0016.

Kukharenko, E., & Borovskii, A. (2017). The methodology for the formation of tariff plans taking into account the differentiation of the quality of mobile services. *Economics and Quality of Communication Systems, 3.*

Larichkina, D. (2015). Features of the development of the telecommunications services industry in Russia. *International Journal of Applied and Basic Research, 5*(3).

Lee, S., Levendis, J., & Gutierrez, L. (2012). Telecommunications and economic growth: an empirical analysis of Sub-Saharan Africa. *Applied Economics, 44.* doi: 10.2139/ssrn.1567703.

Madlenakova, L., Matuskova, M., Madlenak, R., & Dro´zdziel, P. (2018). Quantitative analysis of the competitive environment in the electronic communications sector. In I. Kabashkin, I. Yatskiv & I. Prentkovskis (Eds.). *Proceedings of the 17th international conference on reliability and statistics in transportation and communication (RelStat)*. Riga: Springer-Dordrecht, Netherlands. doi: 10.1007/978-3-319-74454-4_40.

Ndiaye, B., & Thiaw, Ch. A. L. (2011). Positioning strategies in case of oligopolistic competition: the case of telecommunications industry in Senegal. *African Journal of Business Management, 5*(16).

Semenov, S. (2011). The impact of the financial crisis on the state of the mobile services market. *Vestnik of the Plekhanov Russian University of Economics, 1.*

Shcherbina, T. (2016). The development of the economic potential of mobile operators in a crisis. *New Science: Strategies & Vectors of Development, 1-2*.

Shpagina, N. (2009). Problems of calculating the cost of services in mobile companies. *Vestnik of the Saratov State Socio-Economic University, 1*.

Spitsyn, A. (2016). The development of the telecommunications industry in Russia: problems, prospects. *Horizons of the Economy, 3.*

Sridhar, K., & Sridhar, V. (2007). Telecommunications infrastructure and economic growth: evidence from developing countries. *Applied Econometrics and International Development, 7*(2).

Sznajd-Weron, K., Weron, R., & Włoszczowska, M. (2008). Outflow dynamics in modeling oligopoly markets: the case of the mobile telecommunications market in Poland. *Journal of Statistical Mechanics: Theory and Experiment, 2008.* doi: 10.1088/1742-5468/2008/11/P11018.

The Russian Federal State Statistics Service. (2016). *Transport and Communication in Russia: 2016. Statistical Digest.* Retrieved from: https://www.gks.ru/free_ doc/doc_2016/ transp-sv16.pdf (26.11.2019).

Tulyakova, I., Dengov, V., & Shkorova, K. (2017). Globalization and the telecommunication market of Russia: pricing strategies of the dominant operators. In T. Kliestik (Ed.). *Proceedings of the 17th international scientific conference on globalization and its socio-economics consequences.* Rajecke Teplice: University of Zilina.

Valaskova, K., Durica, M., Kovacova, M., Gregova, E., & Lazaroiu, G. (2019). Oligopolistic competition among providers in the telecommunication industry: the case of Slovakia. *Administrative Sciences, 9.* doi: 10.3390/ admsci9030049.

Valletti, T. M. (2003). Is mobile telephony a natural oligopoly? *Review of Industrial Organization, 22*(1). doi: 10.1023/A:1022191701357.

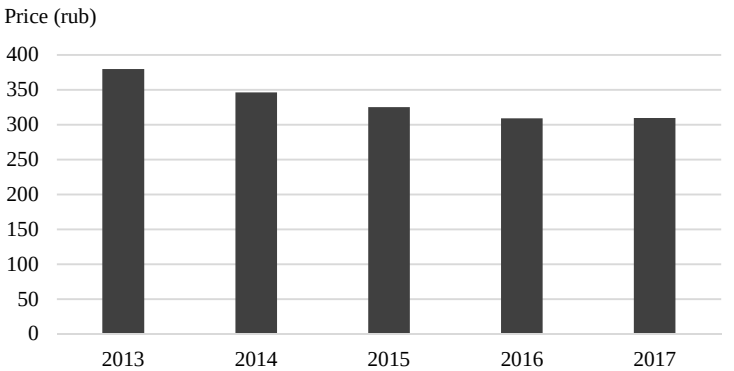
Waverman, L., Meschi, M., & Fuss, M. (2005). The impact of telecoms on economic growth in developing countries. *Vodafone Policy Paper, 2*.

Annex

Table 1. The average monthly salaries in the UK and RF and the shares of the average tariffs for mobile services in the average monthly salaries for labor specialties

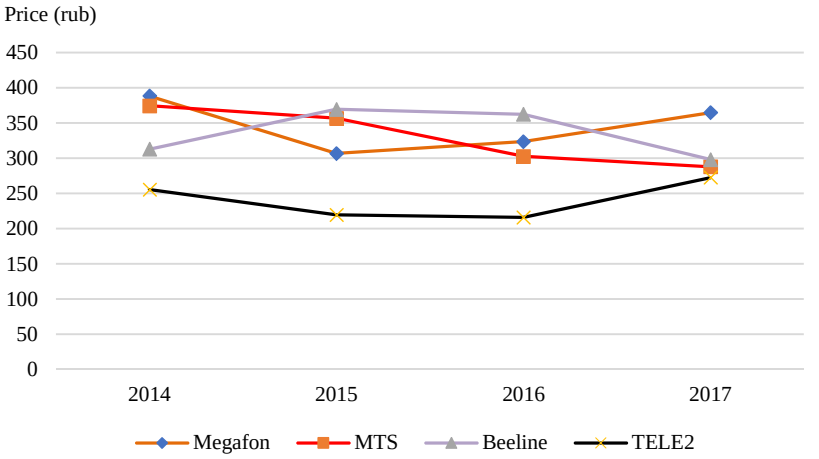
Specialty	The average monthly income in the UK (RUB)	The average monthly income in RF (RUB)	The share of the average tariff for mobile services in the salary in the UK	The share of the average tariff for mobile services in the salary in RF
Civil engineers	150,780	72,801	0.0055	0.0041
Programmers (IT)	163,345	65,122	0.0051	0.0046
Social workers	156,057	22,111	0.0053	0.0135
Teachers	167,533	32,158	0.0050	0.0093
Medical workers	176,237	27,554	0.0047	0.0109

Figure 1. Dynamics of the average price for mobile services in all regions (RUB)



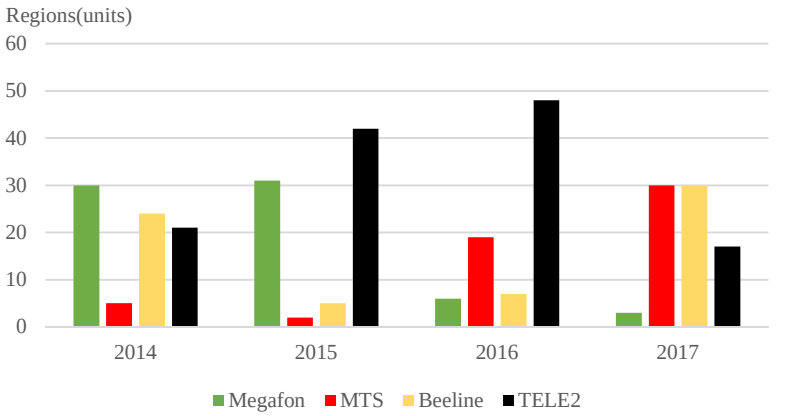
Source: compiled by the authors based on Rosstat (2017).

Figure 2. Dynamics of the average price for mobile services by operators (RUB)



Source: compiled by the authors based on Rosstat (2017).

Figure 3. The number of regions (units) with the best offers from operators



Source: compiled by the authors based on Rosstat (2017).

Figure 4. Amur region

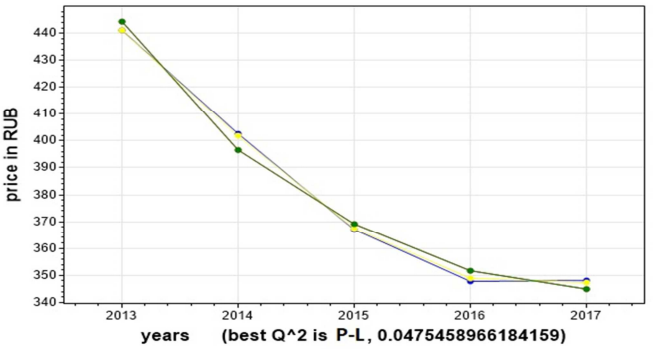


Figure 5. Moscow and Moscow region

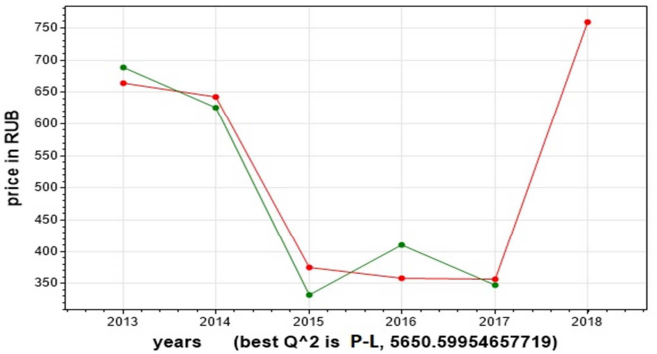


Figure 6. Sverdlovsk region