European Proceedings of
Social and Behavioural Sciences
EpSBS

www.europeanproceedings.com
e-ISSN: 2357-1330

DOI: 10.15405/epsbs.2020.03.02.39

CSIS 2019

11th International Scientific and Theoretical Conference "Communicative Strategies of Information Society"

DEPENDENCE OF A COUNTRY'S COMPETITIVENESS ON ITS INFORMATION INFRASTRUCTURE

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Abstract

The paper focuses on assessment of the countries' competitiveness dependence on their level of the information infrastructure development. The aim of the research is to elicit existence and degree of a country's competitiveness dependence on the level of information infrastructure development. The method of statistical data processing, namely correlation-regression analysis, was used as a mathematical apparatus. Calculations were carried out with Microsoft Excel's "Data analysis" package. The Global Competitiveness Index of countries (ranking) was chosen as a result factor, with the following sign factors: number of mobile-cellular subscriptions, number of mobile-broadband subscriptions, number of fixed-broadband Internet subscriptions, number of fibre Internet subscriptions, number of Internet users. The regression model obtained reflects the linear dependence of competitiveness on three factors: the number of mobile broadband Internet subscribers, the number of fixed broadband Internet subscribers and the share of Internet users. The 126.44 constant reflects the influence of all other factors not taken into account in the model and, vice versa, negatively affects the ranking of the country. The regression model was tested on the Russian Federation. The model made it possible to determine the forecast level of the global competitiveness index in 2020.

Keywords: Information environment, global competitiveness index, model, dependency, forecast.

https://doi.org/10.15405/epsbs.2020.03.02.39
Corresponding Author: Dilara R. Musina
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

1. Introduction

Digital, or information, infrastructure is a set of organizational structures that ensure functioning and development of a country's information space and means of information communication (Digital Economy of the Russian Federation Program, 2017). The information infrastructure includes information centres, databases and knowledge bases, communication systems, and everything that provides access to information resources for citizens of the country. A country's competitiveness is a set of institutions, policies, and factors that determine the level of productivity measured as the gross domestic product per capita (Lleo, 2018; Kotarski, 2018).

To study the relationship between competitiveness and the level of development of the country's information infrastructure, the following indicators can be taken: as a result factor, the growth rate of the gross domestic product, as indicators of the information infrastructure, indicators included in the calculation of information and communication technology development index (ICT Development Index - IDI) and the Global Innovation Index (Measuring the Information Society Report 2018, 2018; Rankings, 2019).

But in this study, a country's competitiveness is measured by the Global Competitiveness Index 4.0, published annually by the World Economic Forum (Schwab, 2018).

The country's Global Competitiveness Index describes its competitiveness according to 12 indices grouped into subindexes, such as "creating an enabling environment", "markets", "human capital" and "innovation ecosystem".

Each category has its own indicators. The "Enabling environment" subindex includes four subcategories, one of which is "ICT adoption".

"ICT adoption" subcategory includes the following indicators:

- number of mobile-cellular subscriptions per 100 pop.;
- number of mobile-broadband subscriptions per 100 pop.;
- number of fixed-broadband Internet subscriptions per 100 pop.;
- number of fibre Internet subscriptions per 100 pop.;
- number of Internet users, %.

According to the 2018 WEF report (Schwab, 2018), Russia ranked 43rd place out of 140 in terms of competitiveness. According to the indicators of the "ICT adoption" subcategory, the places were distributed as follows:

- number of mobile-cellular subscription – 11;
- number of mobile-broadband subscriptions – 51;
- number of fixed-broadband Internet subscriptions – 46;
- number of fibre Internet subscription – 12;
- Internet users – 49%.

In this subcategory, Russia ranked 25th place.

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2. Problem Statement

Given the rather high rank of Russia in the "ICT adoption" subcategory, as well as the positive dynamics of this subcategory, a mathematical model is required to predict the country's ranking depending on the category indicators forecast.

3. Research Questions

Despite the fact that the Global Competitiveness Index is a synthetic indicator based on the ratio of the 140 countries achievements in various areas, including the ICT adoption, we believe it is possible to carry out a correlation and regression analysis and identify those indicators from the subcategory "ICT adoption" that have a greater impact on the competitiveness of countries. Also, we believe it's possible to identify the regression model, which will provide a forecast of the country's competitiveness depending on the achievements in the field of ICT (Chernova, Starostin, Degtereva, & Andronova, 2019; Ivanova, Poltarykhin, Szromnik, & Aniehkina, 2019).

4. Purpose of the Study

The aim of the research is to elicit existence and degree of a country's competitiveness dependence on the level of information infrastructure development (Abdrahmanova, Vishnevskij, Volkova, & Gohberg, 2018; Annual report 2018-2019, 2019; Dutta, Lanvin, & Wunsch-Vincent, 2018). The choice of goal is due to the need to predict changes in the country's competitiveness under the influence of new information technologies, such as a digital industry platform.

5. Research Methods

Despite the fact that the Global Competitiveness Index is a synthetic indicator based on the ratio of the 140 countries achievements in various areas, including the ICT adoption, we believe it is possible to carry out a correlation and regression analysis and identify those indicators from the subcategory "ICT adoption" that have a greater impact on the competitiveness of countries. Also, we believe it's possible to identify the regression model, which will provide a forecast of the country's competitiveness depending on the achievements in the field of ICT (Chernova, Starostin, Degtereva, & Andronova, 2019; Ivanova, Poltarykhin, Szromnik, & Aniehkina, 2019; Fathian, Fakheri-Fard, Ouarda, Dinpashoh, & Nadoushani, 2019; Mutrakov, Zajnasheva, & Muxametzyanov, 2018; Tukaeva & Muxametzyanov, 2013).

6. Findings

The Global Competitiveness Index of countries (ranking) was chosen as a result factor (y). All markers under the subcategory "ICT adoption", are accepted as sign factors:

- number of mobile-cellular subscriptions – X_1;
- number of mobile-broadband subscriptions – X_2;
- number of fixed-broadband Internet subscriptions – X_3;
- number of fibre Internet subscriptions – X_4;

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- share of Internet users – X_5.

The correlation matrix with the following correlation coefficients is obtained: r_{x1y}=-0,57; r_{x2y}=-0,71; r_{x3y}=-0,84; r_{x4y}=-0,51; r_{x5y}=-0,87. The closest correlation is observed between x_2, x_3, x_5, and y. Factors with correlation coefficients greater than 0.7 per module are left for further analysis. The minus sign means inverse linear dependence. Feedback is explained by the fact that country ratings are accepted as Y. The higher the rating, the lower the number.

The obtained model of multiple linear regression has the following form:

$$y = 126{,}44 – 0{,}22 \cdot x_2 – 1{,}28 \cdot x_3 – 0{,}45 \cdot x_5 .$$

The value of the R-square determination coefficient is 0.82, which indicates that the obtained dependence reflects the observed phenomenon with a sufficient degree of approximation. The significance of the determination coefficient is determined by Fisher's criterion. At the next stage, the significance of regression coefficients aj was checked using the Student's criterion. All factors turned out to be significant, the model did not require improvement.

Thus, the regression equation obtained puts the country's competitiveness in direct dependence on the number of mobile-broadband subscriptions, the number of fixed-broadband Internet subscriptions and the share of Internet users.

The regression equation obtained has the following meaning: the increase in the number of mobile-broadband Internet subscriptions per unit will lead to an increase in the rating by 0.22 points; an increase in the number of fixed-broadband Internet subscriptions per unit will lead to an increase in the rating by 1.28 points; an increase in the share of Internet users by 1% will be followed by an increase in the country ranking by 0.45 points. The constant of 126.44 reflects the influence of all other factors not taken into account in the model and, vice versa negatively affects the ranking of the country. Comparison of the calculated rating of Russia with the actual value allowed to determine the error of the model - 11%.

This model can be used to forecast the impact of changes in state ICT development on its competitiveness. For example, the obtained model allows predicting the change in the global competitiveness index of Russia for the 2020 countries ranking under the influence of only positive changes in the indicators of the "ICT adoption" subcategory, all other conditions being equal. Publicly available information base (Monitoring the development of the information society in the Russian Federation, 2018). Other equal conditions are understood to be the leveling of changes in the ratings of other countries. The forecasted value of the index (rating) of Russia's global competitiveness for 2020 on the basis of the forecasted dynamics of factors in the subcategory "ICT adoption" was 29.

7. Conclusion

7.1.Model scope

The regression model obtained not only predicts the value of the resulting factor but also determines what ICT adoption efforts should be made to achieve the desired value of the global competitiveness index.

Like any other, this model has a number of limitations. Firstly, it is based on linear regression. Secondly, it does not take into account the achievements of other countries, which is defined above as "all things being equal". Thirdly, the model does not take into account the synergetic effect, which implies that the influence of a combination of factors, and not just those of the subcategory "ICT adoption", can lead to greater positive change.

7.2.Directions for further research

The next stage of the research will be the analysis and study of the possibilities of digital economy tools for the development of the Russian agrifood industry in the light of the foreign researchers' developments (Trivelli, Apicella, Chiarello, Rana, Fantoni, & Tarabella, 2019; Iticha & Takele, 2019). This stage includes a critical review of Russian and foreign information systems used at various levels of managing economic processes in agriculture, as well as a review of existing approaches to assessing the level of development of the information infrastructure of the region and the industry. The main research stages and directions are outlined in the authors' works (Musina, Yangirov, Nasyrova, & Haritonov 2019; Musina, Kharitonov, Turganov, & Nizamova, 2019).

Acknowledgments

The reported research was funded by the Russian Foundation for Basic Research and the government of the Bashkortostan Republic of the Russian Federation according to the research project №19-410-020028 p_a.

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