

# THE INFLUENCE OF ICT ON THE ECONOMICS' EFFICIENCY

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**Abstract:** *Currently, the functioning of the economy of any territory can't be imagined without information infrastructure, which affects on all areas of human activity, smoothing differentiation of life quality in urban and rural areas. In this regard, it is important to analyze the impact of ICT on economic performance. One of the best methods may be correlation and regression analysis.*

**Keywords:** *Information and communication technologies, the northern regions, correlation and regression analysis*

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## 1. INTRODUCTION

In modern society, the functioning of the economy of any territory cannot be imagined without an information infrastructure. Information and communication technologies (ICT) become especially relevant for the socio-economic development of hard-to-reach settlements. ICT can be used in various spheres of human activity – telemedicine, e-Prescription, E-learning, e-banking. Due to ICT, it is possible to smooth out the differentiation between the quality of life in the city and in the countryside.

At this moment, there are two points of view about the ICT's impact on the economy efficiency. Followers [Solow, 2009; Solow, 1987; Brynjolfsson, E., 2003] of the first point of view believe that the economy efficiency does not depend on ICT. ICT cannot be a factor of creating competitive advantages and are only a socially necessary infrastructure resource. Nobel laureate Robert Solow in 1987 led the paradox: «You can see the computer age everywhere, but in performance statistics». This paradox refers to the slowdown in productivity growth in the United States in the 1970s and 1980s despite rapid development in the field of ICT over the same period. [Solow, 2009; Solow, 1987]. ICT (free Skype calls, online newspapers / magazines, e-mail) are not fully reflected in official statistics, so it is impossible to assess

their contribution to GDP. A statistical analysis of the data of more than six hundred companies, conducted by Eric Brianjolfson, revealed that it takes 5-7 years to show the effect of increasing productivity through investments in ICT. For every dollar invested in computer equipment, companies need to invest another nine dollars in software, training and business processes. The impact of ICT (exactly how and to what extent) on economic growth and productivity is poorly predictable and difficult to identify.

In recent years, studies that disprove the Solow paradox had been appeared. They show that ICT impact on productivity and competitiveness. The analysis led to the conclusion that the total efficiency of ICT use can be considered in two aspects and at three levels:

- economic aspect - ICT influence the growth of the territory's economy (country, region) or enterprises (GDP / GRP, productivity, competitiveness);
- social aspect - ICT, being an important element of the social infrastructure, influence the increase in the living standards of the population (Table 1).

According to the estimates of the McKinsey, 12% of the world trade is carried out through Internet trading. According to the WEF [The Global Information Technology Report, 2015], ICT (fixed and mobile telephony, broadband Internet access) affects GDP growth and the level of global poverty. Even a 10 percent increase in fixed broadband penetration results in a 1,35 percent increase in GDP growth in developing countries and a 1,19 percent increase in developed economies. The level of absolute poverty in the world (the number of people whose income is less than \$ 1.25 per day) fell from 1,9 billion in 1981 to 1,3 billion in 2010. But at the same time, the WEF has revealed another paradox: ICT driving economic growth and leading to decreasing global inequality at the same time contribute within-country income inequality

Experts believe that informatization of health care can significantly reduce costs. In particular, the introduction of an information system for patient registration reduced expenditures by AU\$300 million per year, by reducing the number of errors and duplicating the actions of medical personnel (Australia), and replacing the paper recipes with electronic prescriptions helped to reduce costs by €180 million per year (Germany).

An analysis of the ICT's effectiveness was carried out on the example of the Russian Federation's northern regions, the territories of which fully belong to the regions of the Far North and equated areas: the European North - the Komi Republic, the Karelia Republic, the Arkhangelsk and Murmansk regions; Asian North - the Sakha Republic (Yakutia), the Tyva Republic, Kamchatka Territory, Magadan and Sakhalin regions, Khanty-Mansiysky, Yamalo-Nenets, Chukotsky Autonomous Areas. The indicators of the society's informatization were analyzed from open official sources [The Komi Republic in figures, 2016; The Karelia Republic in figures, 2016; The Arkhangelsk region in figures, 2015; The Murmansk region in figures, 2015; The Khanty-Mansiysky Autonomous Area in figures, 2016; The Tyva Republic in figures, 2016; The Magadan region in figures, 2016]. Due to the lack of data, the analysis was conducted in the whole region, without division into urban and rural areas.

**Table 1.** Methodological approaches to the analysis of the ICT's effectiveness

Methodological approach	Author	Difficulties of calculations
Territory		
Statistical methods: correlation and regression analysis	Jason Dedrick, Kenneth L. Kraemer, Eric Shih [Platonov, 2007]	Simplicity and clarity. It allows you to set the presence and closeness of the relationship, but not causation.
	The Computing Technology Industry Association [Platonov, 2007]	
	McKinsey Global Institute [Ten ideas to maximize the socioeconomic impact of ICT, 2015]	
	World Economic Forum (WEF) [The Global Information Technology Report, 2015]	
Social infrastructure		
Estimation of economic efficiency	Vladimirsky A.V. [Vladimirsky, 2011; Vladimirsky, 2007]	Absence of all necessary statistical data in the open access. It is necessary to take into account the time lag. The influence of ICT is vaguely indicated.
Parametric model (application of ICT in health care)	Shavrin Yu.A., Lebedev G.S, Tikhonova Yu.V. [Shavrin, 2013]	Absence of all necessary statistical data in the open access.
Monitoring (application of ICT in education)	UNESCO Institute for Statistics [Guide to measuring ICT in education, 2009]	Absence of all necessary statistical data in the open access. It is necessary to carry out a global sociological survey of educational organizations.
Enterprise		
Financial methods: 1. Information Productivity	Paul Strassmann [Strassmann, 1997; Pisello, 2010]	Complexity in the calculations due to the indirect influence of ICT. It is impossible to explain causality with accuracy. It is necessary to take into account the time lag.
2. «Intuitive» model	Sarv Devaraj, Rajiv Kohli [Devaraj, 2006]	
3. The integral index	Ermakova Zh.A., Pergunova O.V., Parusimova N.I. [Ermakova, 2014]	
Econometric methods: based on the Cobb-Douglas production function	Platonov V.V. [Platonov, 2007] Mary O'Mahony, Michela Vecchi [O'Mahony, 2002]	

## 2. DATA AND PRELIMINARY EMPIRICAL RESULTS

One of the most important factors of spatial differentiation of ICT is the social welfare factor. The coefficient of correlation between GRP per capita and a number of indicators of ICT distribution in Russia during 2010-2015 was 0,9. It shows a strong positive relationship between the indicators.

The correlation coefficient between GRP and the volume of communication services in all regions of the the Russian North was from 0,8 to 0,9, which also shows a positive effect on the GRP level.

A high correlation coefficient between GRP and ICT costs is observed practically in all regions of the Russian North, except for the Karelia Republic, the Arkhangelsk Region, Sakhalin Region and Magadan Region. One of the reasons for this is that the costs of ICT are laid in the regions' budgets for the medium-term perspective according to the planned indicators.

The next factor that is important for the development of ICT in the region can be designated as innovation. The costs on the development of ICT (acquisition of computers, software, payment for telecommunication services, training of employees, payment for services of third-party organizations and ICT specialists) in the regions of the European North increased in 2014 by 30% compared to 2010. The greatest increase of costs on the development of ICT (45%) occurred in the Republic of Karelia and in the Arkhangelsk region. In the regions of the Asian North and Russia as a whole, the costs on the development of ICT have doubled. Among the regions of the Asian North, the greatest increase of the costs on the development of ICT occurred in the Yamalo-Nenets Autonomous District. In this region, the costs on the development of ICT have grown six-fold.

The volume of investments in fixed assets for the acquisition of ICT also increased in 2014 compared to 2010. In the European North, the volume of investments increased by 58%. In the regions of the Asian North the volume of investments increased by 6%. In whole Russia the volume of investments increased by 71%. A positive strong correlation between GRP and the volume of investments in fixed assets for the acquisition of various information and communication equipment is observed in all northern regions of Russia.

ICT made the largest contribution to the GDP's growth through human capital, improving the quality of life of the population. According to Maslow's pyramid, ICT can be classified as higher needs groups:

- social connections – ICT can satisfy the need for distance communication, new types of ICT can identify a person as belonging to a particular class;
- the need for self-actualization – ICT can realize a person's abilities, his self-education, primarily due to the possibilities of the Internet.

Therefore, it is not surprising that there is a strong positive correlation between GRP and the number of computers in households - from 0,70 to 0,97. A weak correlation between GRP and the number of mobile phones is observed in the Kamchatka Territory and the Murmansk region.

An important factor is the availability of IT infrastructure (computers, office equipment, servers, data network software, telephone networks). It is no accident that the correlation coefficient between the number of computers and the number of households with Internet access, as well as the number of Internet users, ranges from 0,73 to 0,99.

In the regions of the European North the number of personal computers used in

healthcare facilities per 100 doctors in 2014 increased by 14%, compared to 2012 and in the regions of the Asian North - by 17%. In whole Russia this indicator grew by 8%. The number of computers connected to the Internet has also increased. In the regions of the European North this indicator grew by 50%, in the regions of the Asian North – by 63%, and in whole Russia – by 36%.

### 3. REGIONAL FEATURES

Let's consider in more detail the impact of ICT on the economy of one of the regions of the Russian North - the Komi Republic. The Komi Republic is located in the northeast of the European part of the Russian Federation.

In previous studies, we found that an important factor affecting the distribution of ICT in the Komi Republic, especially in rural areas, is the geographical factor. The development of new types of communication in the region is greatly influenced by the basic infrastructure. In particular the development of the Internet network is still taking place along the transport and economic axis. The spread of ICT in the republic is characterized by an urban orientation. Almost two-thirds of the population lives in the cities of the republic. Large organizations and branches of federal organizations, large educational and healthcare institutions are also located in cities. There is a differentiation of access to information and communication services, both in terms of the number of operators and the quality of communication in urban and rural areas. The configuration of the location of ICT networks leads to the emergence of one of the types of social inequality of the population - the «digital inequality».

Due to the fact that only 14% of the total number of organizations in the region are located in rural areas, their ICT development indicators are not high in all-republican indicators, but they grow from year to year (Table 2).

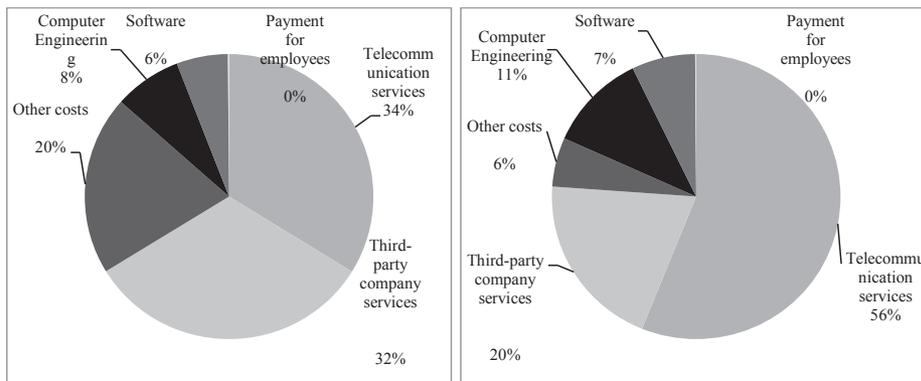
**Table 2.** Use of ICT in organizations located in urban and rural areas of the Komi Republic for the period 2007-2015.

Indicators	Urban areas	Rural areas
Organizations using the PC, %	70	30
Organizations using local-area networks (LANs), %	73	27
Organizations using the Internet, %	71	29
Organizations that have a website,%	85	15
Costs of organizations for ICT development, %	97,5	2,5

In 2015, compared to 2007, in rural areas of the region, the number of organizations using PCs increased by 3%, LANs - 12%, Internet - 51%. The number of organizations with websites has increased seven-fold over the period. The cost of ICT increased by 83%.

For one year, one urban organization spends more than 400 thousand rubles on the development of ICT. The ICT costs of organizations in rural areas are eight times less. In the cost structure of urban organization the largest share is spent on paying for services of third-party organizations and ICT specialists (30.1%), as well as payment for telecommunication

services (27.2%) (Figure 1). In organizations located in rural areas, more than half of all ICT costs relate to the payment of telecommunication services. This is due to the fact that in rural areas there is no possibility to choose a provider of telecommunication services, to choose a tariff or there are no communication lines at all. This fact forces the organizations to use satellite connection, which leads to high costs. Urban organizations spend quite a lot of money (20%) on other costs, which include the costs of developing software tools on their own. The costs for staff involved in the development of ICT in organizations in urban and rural areas are very small – only 0,12% of total costs. This can constrain the development of ICT.



**Figure 1.** Structure of ICT's costs of organizations in urban and rural areas of the Komi Republic

The correlation analysis between the balanced financial result of organizations' activities and ICT development indicators (ICT costs, number of PCs in organizations, connection of organizations to the Internet and the availability of the organization's website) revealed the correlation with medium or low strength between the indicators.

Due to the fact that one of the leading industries in the Komi Republic is the forest industry, it was decided to analyze the effectiveness of ICT introduction in enterprises of this industry. However, statistical agencies do not provide data on the costs of enterprises that are classified as «commercial secrets» of enterprises. So the cost of ICT for a forest enterprise was estimated. It was also revealed that the head offices of enterprises take into account the total costs of ICT, including the costs of their branches, so it is impossible to determine territorially where these costs were incurred.

The conducted correlation analysis revealed a positive dependence of profit on the cost of ICT in wood processing enterprises. The enterprises with negative correlation dependence were also revealed, one of them is in the rural area.

## 4. CONCLUSION

ICT are a tool that improves the quality of life of the population, which is especially important for rural areas. However, their effectiveness in Russia is difficult to assess because of the lack of statistical data. One of the best methods for assessing ICT for efficiency can be correlation and regression analysis. The analysis made it possible to conclude that the key factors of spatial differentiation of ICT in the Komi Republic are the social well-being and geographical features of the region. There is a positive impact on the GRP level of the volume of communication services, ICT costs and investments aimed at the acquisition of information and communication equipment. ICT costs of organizations located in rural areas are much less than those of urban organizations. The analysis revealed the dependence of profit of forest industry organizations on the cost of ICT.

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