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Investments in the Digitalization of Service Companies as a Source of Well-Being of the Population of the Regions

V.A. Yakimova, S.V. Khmura
Amur State University, Blagoveshchensk, Russia

ABSTRACT

The article assesses the impact of investments in the digitization of service organizations on population well-being indices across Russia's regions. The **relevance** of the study is reduced to the fact that in the context of digitalization of the economy there is a dynamic development of the service sector, which becomes a driver of the growth of the quality and standard of living of the population. The **purpose** of the study is to determine the presence of economic effects from investments in digitalization that contribute to the improvement of the level and quality of life of the population in the region. The objectives of the study are theoretically justify the selection of indicators for assessing the well-being of the regional population, investments in the digitalization of service organizations depending on the type of region, and the calculation of digital effects. Methods of assessment of par correlations, typology, and panel data used to conduct spatial-time analysis. 85 regions of Russia were selected as the objects of study, and the research period includes the pre-pandemic and pandemic period, the impact of which led to an increase in investment in digital technologies in the service sector. The study tested the scientific hypothesis that investment in the digitalization of the service sector contributes to an increase in the volume of services, their availability and their quality, which, in turn, leads to an increase in the well-being of the population. The analysis carried out did not allow us to fully confirm the hypothesis, since there are differences between regions and types of services. The **novelty** of the study is in the formed spatial-time models, reflecting the relationship between investment in the digitalization of the services sphere and the factors determining the quality of life of the population of the regions of Russia. The analysis did not fully support the hypothesis, as there were differences between regions and types of services. It **concluded** that the investment increased the population's use of computer equipment and service volumes, as well as their ability to save more money and use services for managing their personal finances.

Keywords: service economy; digitalization of the service sector; welfare of the population of the region; indicators of quality of life; welfare economics; investments in digitalization; digital infrastructure for quality of life; digitalization indices

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INTRODUCTION

The transition to the new economy is accompanied by the rapid development of services. For example, in developed countries, the services sector accounts for a substantial share of GDP: in the USA — about 80%, in Japan — over 70%. These trends contribute to a new phenomenon, the service economy, which allows individuals to save money on transaction costs connected with e-services while maintaining access to reliable public services. At the priority level of the State, the goal of the development of the service economy is set in the national project "Digital economy", according to which the basis of development of society is the provision of "new quality of life, business and public services". I.N. Tkachenko and E.N. Starikov [1] argue that the digital economy causes socio-economic transformations of public life. S. Xiang et al. [2], A. Grybauskas et al. [3], M. Spence [4] considers that services-oriented regions are not experiencing poor quality of life by leveraging the benefits of digitalization. Instruments of the system for improving the welfare of the population are the services of organizations — telemedicine, distance education, e-government and financial services.

While digitalization contributes to the welfare of individuals in developed countries, it does not in developing countries. The causes of the imbalances are negative factors such as digital divides, income polarization, insufficient digital literacy among the public, increasing morbidity as a result of the COVID-19 pandemic, social conflict, cyber fraud etc.

A.V. Vorontsovskiy notes that the development of Internet services may not contribute to the growth of public welfare, although the welfare of individuals may increase [5]. The studies noted the absence of effects from digitization on the quality of life of the population [6, 7], which is caused, in the opinion of the authors, by the Russian economy in the initial phase of digitization. In the development phase, investment in service organizations, i.e. investment of financial capital for the acquisition and implementation of digital technology and software, is an important catalyst. The consideration of digital effects at the regional level is due to the fact that the region is a "complexly functioning economic-socio-environmental system with individual economic, socio-demographic, infrastructural and other features" [8]. In the regions, conditions and opportunities for the living of the population in the given territory are formed. Regions' unequal investment, policy effectiveness and differences in governance tools determine the need to study regional differentiation of welfare. The purpose of the study is to assess the relationship between the growth of investment in the digitalization of services and the indicators characterizing the welfare of the population. The objectives of the study are:

- identification of a set of indicators for assessing the welfare of the population that may change as a result of digital transformation in the regions;
- assessment of investment in the digitization of service organizations depending on the typology of regions and the quality of life of the population;
- determination of digital effects by identifying the relationship between investment in the digitization of service organizations of the region and indicators of the welfare of the population through spatial-time analysis.

EVALUATION OF THE DIGITAL IMPACT ON THE WELFARE OF THE POPULATION OF THE REGION

Welfare economics has been developed in Bergson-Samuelson's paper (the approach of general welfare and the theory of social choice), A. Baujard's concept of "welfarism" [9], from the point of view of classical utilitarians (welfare as prosperity and happiness), T. Grüne-Yanoff's behavioral welfare theory

[10] (the study of the preferences of economic agents and social justice). M.S. Pecherkina, I.V. Korobkov [8] reveals the category of "welfare of the region" from the perspective of the quality of life of the individual and socio-economic development of the area, and indicators include the general economic, structural, social and economic, demographic, economic, environmental and financial spheres. Welfare represents the extent to which a society provides services to meet its needs. The growth mechanism of the region's welfare is based on efficient reproduction due to the image of the area and the availability of service services to the population in the region. Economic and material conditions (monetary income, ratio of consumption and savings), human capital indicators (housing conditions, employment, health and education system), the state of the economy, public administration, and the environment comprise some of the criteria used to assess the welfare of the region's population [6, 11–13].

Regional welfare is achieved by improving the quality of life of the population. The category "quality of life" is sufficiently researched and is considered from the perspective of components that reflect important aspects of people's life activities [14]. The standard of living as a measure of the welfare of the population is characterized by the "degree of satisfaction of material needs" [6]. Quality of life, as an indicator of socio-economic development of the region, includes objective and subjective factors, such as health, life expectancy, living conditions and comfort, social environment, safety, etc. [15, 16]. V.V. Okrepilov, N.L. Gagulina [17] among the characteristics of quality of life, apart from those listed, are material welfare, the development of regional infrastructure, the comfort of climatic conditions and the political environment.

Although indicators and measurement methodologies have been examined, indicators must be chosen to assess the influence of digital transformation on the welfare of the region's population. G.P. Litvintseva and I.N. Karelin [7] introduces the concept of "digital quality of life", which means the digital component is measured by the availability of digital competences, the quality of the labor sphere, e-government services and Internet security. The digital effect on the population's quality of life has both an objective (access to digital infrastructure, digital platforms) and subjective (social comfort through the use of digital technology) scope [16].

The influence of digitalization on service organizations was studied by Yu.I. Seliverstov [18], noting the creation of ways of serving customers and effective forms of interaction with them. According to A.V. Vorontsovskiy [5], digitalization includes online services, online stores, allowing for the extraction of income through the processing of information for the operation of services. O.V. Artemova et al. [14] consider the digital component of quality of life, expanding the possibility of meeting needs in digital form. Social and financial services, the Internet, mobile phones are being made available to rural and low-income populations [19]. The development of the G.P. Litvintseva and I.N. Karelin [7] correlation models has shown the positive impact of e-government services on the welfare of society. Positive impacts identified include the expansion of the boundaries of accessibility and convenience of services, receiving real-time education and increasing productivity.

It has research aimed at segmenting of the service sphere and identifying the peculiarities of its segments. K.S. Friesenbichler and A. Kügler [20] assessed the relationship between the share of services (market, financial, high-technology science-intensive services) and productivity growth and changes in employment structure. It was found that when the region's economy develops, the share of the service economy increases, service services in production expand, and science-intensive services limit

factor productivity growth. U. Witt and C. Gross [21] based on the construction of the production function model identified the peculiarities of the sphere of services in the efficient use of digital technologies and energy savings. In the service sector, unit labour costs are higher than in industry, and productivity is growing at a slow pace. Improved competitiveness conditions favor equalization of labour productivity and wages in the sectors. Examples of indicators suggest that a universal methodology for assessing the welfare of the region with regard to the digitalization of the services sector has not been developed, so it is proposed to identify indicators and assess the relationship between variables.

RESEARCH METHODICS

In order to conduct the study, it is proposed to use investments in the digitization of service organizations, an integral indicator of quality of life, published by the rating agency "RIA Rating" in the regions of Russia. The indicators considered are classified as follows: quality of life, population well-being, working life quality, social sphere, and life safety. Selected statistics represent indicators that are to be digitized.

Panel analysis is chosen as a method to establish space-time relationships. Fixed variable of the study — period 2017–2021, object of study — region. The choice of the period is because digital effects can be manifested, starting in 2017, during the period of activities during the implementation of the national program "Digital Economy of the Russian Federation" and adopted strategies of digital transformation of regions. Since 2017, the statistical database has been improved and indicators for measuring digital effects have been introduced.

A greater interest for the study is the fixed-effect model, as it is applied to the general aggregate objects (regions) and explains the dependent variable (K_{ijk}) of the general average, the differentiated effects of the effects of factors and their combination. Changes develop repeatedly in different places through different periods. A fixed variable model describes estimates of individual effects, which are variable coefficients. Effects are defined using a basic model:

$$K_{ijk} = const + \mu + \alpha_i + \beta_1 K_1 + \beta_2 K_2 + \\ + \beta_3 K_3 + \ldots + \beta_n K_n + (\alpha\beta)_{ij} + \varepsilon_{ijk},$$

where μ — total average; α_i, β_j — effect (fixed or random) on the *i*- levels of influence of factors; $(\alpha\beta)_{ij}$ — effect of their interaction; ε_{ijk} — residues in normally distributed model.

REGIONAL ECONOMIC SERVICES DISBALANS: THE IMPACT OF THE COVID-19 PANDEMIC

The share of the services sector in the Russian economy has a special significance, starting from 2019 there is a gradual growth in the structure of the GRP. Services accounted for 43% in 2017 and 44.3% in 2020. Investments in the range of activities of service organizations are presented in *Fig. 1*.

The increase in the share of services is due to the impact of COVID-19, which is caused by a decline in production and increased investment in digital hardware and video communication programs for the provision of services in remote format. The service sector recovered at a faster rate than industry during the pandemic. The largest share of investments in digitalization is recorded in the sector of communications organizations, and since 2019, it has grown significantly. Growth is attributable to the importance of the telecommunications sector for digital transformation and the functioning of all subsystems of the economy.

The second largest investment sector is financial and insurance, with the growth rate of digitalization in 2020–2021 higher than in other sectors. This fact is due to the development of online-services, allowing obtaining part of the services without physical visit to the offices of banks and

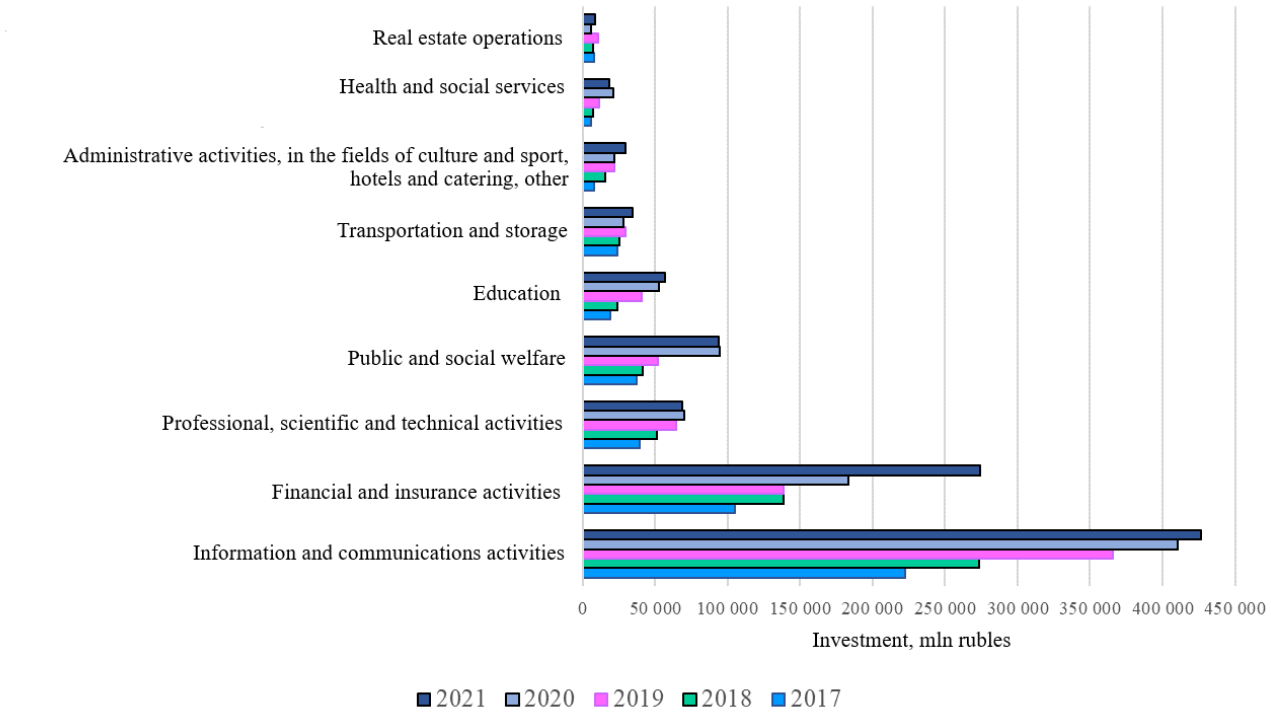

Fig. 1. **Investments in ICT of Service Organizations (According to Russia) for 2017–2021**
Source: Compiled by the authors.

insurance companies. At the third place in the share of investments — organization of science and technology activities and public services. The growth of investment in the digitization of the public sector is linked to the increased demand for services — receiving incentives, social payments and vaccination certificates. During the pandemic, healthcare, transportation and tourism organizations were significantly affected, and remote technologies compensated for the losses.

Online consulting, pharmaceutical applications, diagnosis and testing of COVID-19 have increased in healthcare. In education, investments are aimed at projects on the recording of personal data, the creation of electronic textbooks, the digitization of plans and the widespread use of distance learning methods. At the same time, despite the high demand, less investment has been directed to the digitization of healthcare facilities, their digital technologies. In addition, the financing of the digital infrastructure of cultural institutions, libraries, and museums is at a low level, which leads to a low level of digitalization in this area, including due to significant restrictions on the functioning of these institutions in 2020.

Fig. 2 shows an assessment of the relationship between investment in digital technologies in the services sector and the quality of life of the population of the regions.

The interrelationship of the factors studied is at an average level with a correlation coefficient of 0.44, indicating the high differentiation of digitalization of the regions. The large gap between Moscow and St. Petersburg as centers of digital standard of living, from other regions is due to the effect of programs of development of health care, electronic history of illness, high level of digitization of education programs, digitalization of materials with cultural value, online services in tourism. In Moscow, the "Smart City — 2030" project is currently performed, which provides a wide range of chances for digital economy training and urban planning optimization.

The uniqueness of digital agglomerations is associated with the creation of growth points

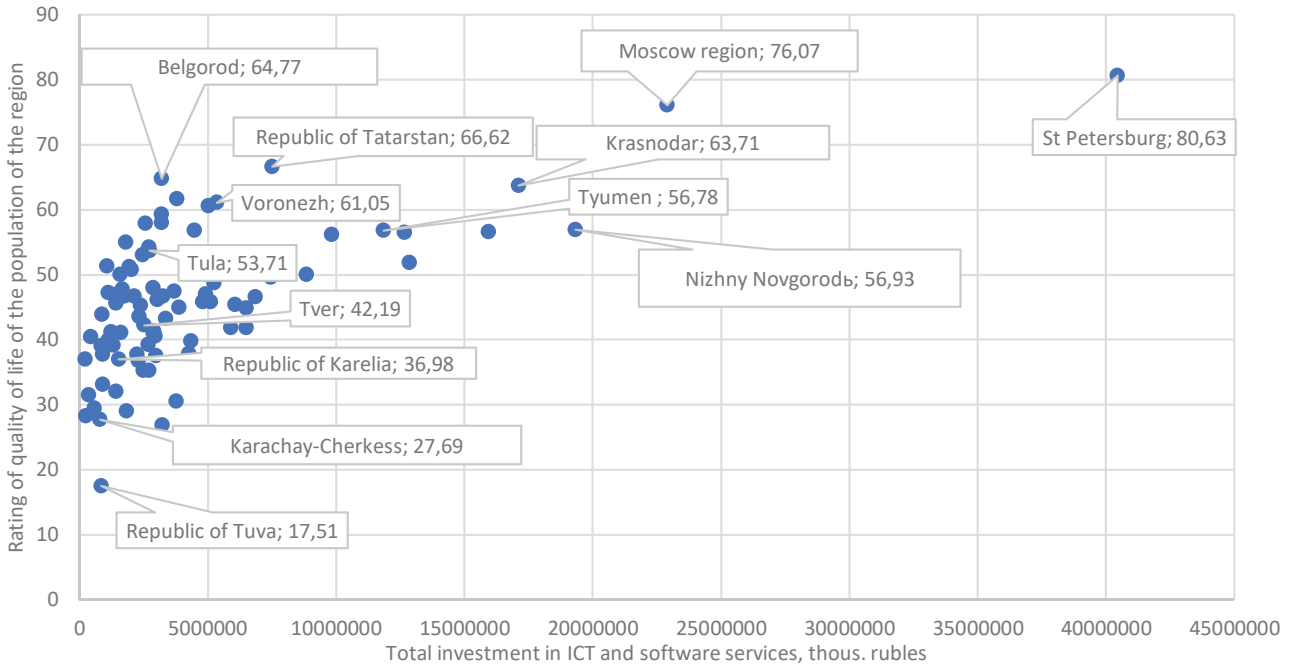

Fig. 2. **Scatterplot for Assessing the Correlation Between Investment in ICT of Service Organizations and the Rating of Quality of Life in the Region**

Source: Compiled by the authors.

Note: The city of Moscow, which has the highest amount of investment in the ICT sector, is excluded due to strong differences from other regions.

and the development of system projects that become a transfer for application throughout Russia and are designed to improve the welfare of the population in other regions. Four types of regions have been identified based on quality of life indicators and the amount of investment (*Table 1*).

A group of regions with a high quality of life includes regions that serve as centers of service promotion. Regions with low quality of life mainly include actors with national and cultural characteristics, as well as low levels of service development. Investments in service digitization are higher in high quality of life regions due to high levels of economic development. The differences are a result of regional infrastructure and the context of institutions. Despite low investment in ICT and software for service companies, the Republic of Tuva has the lowest population rating of quality of life, owing to the insufficient initial contribution of programs to improving life quality. Unequal investment in service digitization across regions may have negative socioeconomic effects.

IMPACT OF INVESTMENTS IN THE DIGITALIZATION OF SERVICE ORGANIZATIONS ON WELFARE INDICATORS

Investing in the digitalization of service organizations contributes to both increased service volumes and improved service quality. To examine the impact of digitalization investments, a correlation matrix has been developed, identifying the type of relationship between investments and population welfare indicators for Russia's regions in 2021 (*Table 2*).

Investments in digital technology are responsible for an increase in health, education, postal, and courier services; the pandemic period increased this trend significantly by creating a need for social separation. The growth of telecommunications services is linked

Table 1

Typology of Regions in Terms of the Quality of Life of the Population and Investments in the Digitalization of Service Organizations for 2021

Type of region by quality of life	Region examples	Average level of investment in ICT and software in the service sector, thousand rubles.	Average level of quality of life of the population
With high	Moscow, St. Petersburg, Moscow Region	188081867	79.62
Elevated	Republic of Tatarstan, Belgorod region, Krasnodar region, Voronezh region, Khanty-Mansiysky district, Kaliningrad region, Lipetsk region, etc.	6756234.8	56.91
Average	Kamchatka region, Ryazan region, Republic of Bashkortostan, Khabarovsk region, Yaroslavl region, Vladimir region, Ulyanovsk region, Orenburg region, Orel region, Primorsky region, etc.	2982218.6	42.22
Low	Republic of Kalmykia, Kabardino-Balkar Republic, Republic of Ingushetia, Kurgan region, Republic of Altai, Republic of Buryatia, Jewish Autonomous Region, etc.	1389574	28.57

Source: Compiled by the authors.

to the need to support other services in online form. The high level of correlation between the volume of investments in ICT of educational organizations and variables (number of computers, volume of services, including telecommunications) is due to the increased level of technical and information equipment and computer literacy of the population. Professors' involvement in remote training programs was made possible by investments in the digitalization of education.

There is a strong link between investment in digitalization of services and population savings, which is caused by the improvement of the quality of financial services of banks through online applications and the desire of the population to accumulate funds rather than spend on consumption during economic crises. The economic return from investments in the digitalization of the financial sector is demonstrated by the correlation factor with the share of the finance sector in the structure of the GDP — 0.65. Investments in financial institutions' ICTs lead to improved software for accessibility of financial and insurance instruments. This will contribute to increased deposits of individuals, as well as increased demand for health services through insurance. Simultaneously, demand for electronic

Table 2

Ranking Pearson's Correlation Coefficients According to the Degree of Significance of the Factor Dependence of Investments and Indicators of the Well-Being of the Population

	Investments in fixed capital of ICT and software of large and medium-sized organizations in the field:				
Variable	**services**	**financial and insurance sector**	**public administration**	**healthcare**	**education**
Factors reflecting the relationship between variables					
Volume of deposits of individuals in banks	0.969**	0.946**	0.958**	0.916**	0.969**
Number of personal computers	0.921**	0.889**	0.910**	0.933**	0.974**
Number of registered diseases in patients diagnosed for the first time in their lives, un.	0.904**	0.870**	0.892**	0.927**	0.958**
Amount of medical services provided	0.938**	0.910**	0.930**	0.929**	0.958**
Volume of educational services	0.931**	0.903**	0.921**	0.935**	0.958**
Volume of telecommunication services	0.930**	0.898**	0.918**	0.936**	0.974**
Postal and courier services	0.909**	0.879**	0.903**	0.913**	0.951**
Resident population of the region	0.719**	0.670**	0.712**	0.877**	0.848**
Volume of deposits of individuals in banks per capita	0.656**	0.630**	0.648**	0.630**	0.709**
Share of financial sector and insurance in GRP	0.674**	0.653**	0.646**	0.696**	0.672**
Factors reflecting low or no dependence					
Number of educational staff participating in additional general education programmes	0.349**	0.290**	0.347**	0.596**	0.586**
Retail turnover per capita	0.441**	0.409**	0.445**	0.534**	0.561**
Migration growth	–0.593**	–0.594**	–0.570**	–0.475**	–0.506**
Average monthly nominal wage per employee per full range of organizations	0.303**	0.297**	0.308**	0.241*	0.353**
Ratio of monetary income of the population to the value of a fixed set of consumer goods and services	0.285**	0.263**	0.241**	0.262**	0.349**
Number of Internet users per 100 inhabitants	0.238*	0.220*	0.265*	0.240*	0.349**
Natural population growth	–0.247*	–0.206	–0.220*	–0.440**	–0.322**
Life expectancy at birth (annual rate)	0.272*	0.264*	0.269*	0.266*	0.298**
Unemployment rate	–0.148	–0.123	–0.142	–0.278**	–0.254*
Share of health and social services in GRP	–0.139	–0.126	–0.145	–0.197	–0.231*
GRP per capita	0.117	0.118	0.117	0.045	0.158
Labour productivity index	0.014	0.027	0.043	–0.079	–0.086
Expenditure of the population on goods and services	–0.062	–0.077	–0.061	0.111	–0.021

Source: Compiled by the authors.

Table 3

Dynamic Spatial Model of the Dependence of Investments in ICT Organizations in the Service Sector and Variables that Determine the Level of Well-Being of Russian Regions

Factor / Variable	Model 1		Model 2		Model 3	
	Investments in digitalization of service organizations	t (p)	Investments in digitalization of service organizations	t (p)	Investments in digitalization of service organizations	t (p)
Constant	0.000001 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Resident population of the region	−12.1 (1.01)	−12 (0)	–	–	–	–
Number of personal computers	60.91 (13.34)	4.57 (0)	87.22 (15.64)	5.58 (0)	83 (8.77)	9.46 (0)
Volume of deposits of individuals in banks	5.57 (0.5)	11.24 (0)	5.11 (0.57)	9.08 (0)	6.66 (0.51)	12.97 (0)
Postal and courier services	12.77 (1.84)	6.95 (0)	12.22 (1.88)	6.52 (0)	–	–
Telecommunication volume	−0.44 (0.11)	−4.05 (0)	−0.89 (0.11)	−7.94 (0)	−1.39 (0.08)	−18 (0)
Number of educational staff participating in additional general education programmes	–	–	−1185 (132)	−9 (0)	–	–
Natural population growth	–	–	589 (96)	6.13 (0)	–	–
Migration growth	–	–	8025 (1974)	4.07 (0)	–	–
Retail turnover per capita	–	–	−18.22 (8.32)	−2.19 (0.03)	–	–
Number of registered diseases in patients diagnosed for the first time in life	–	–	–	–	−22.44 (2.46)	−9.1 (0)
Volume of medical services provided	–	–	–	–	1.17 (0.05)	21.57 (0)
Repeated measurements (dispersion)	–	–	–	-		
-2 Log- credibility	11965		12018		11878	
Akaike information criterion (AIC)	11981		12040		11894	
Hurwicz — Cai criterion (AICC)	11982		12040		11894	
Bozdogan criterion (CAIC)	12020		12093		11932	
Bayesian information criterion (BIC)	12012		12082		11924	

Source: Compiled by the authors.

Note: Standard errors are indicated in parentheses. The level of significance is indicated in parentheses for the *t*-statistic (at $p < 0{,}05$ the factor is significant). The dependent variable may be repeated in the period 2017–2020. In *F*-statistics, all models have the inequality $F_{набл} > F_{кр}$ at a 5% significance level and the corresponding number of degrees of freedom.

Table 4

Models for the Types of Regions Identified Depending on the Quality of Life Rating

Factor Variable	Model for a type of region with a high level of quality of life		Model for a type with an average level of quality of life	
	Investments in digitalization of service organizations	t (p)	Investments in digitalization of service organizations	t (p)
Constant	0.000000 (0)	0 (0)	–	–
Number of personal computers	192.22 (8.15)	8.17 (0)	–	–
Amount of medical services provided	1.43 (0.18)	7.87 (0)	–	–
Number of registered diseases in patients diagnosed for the first time	–30.07 (9.85)	–3.05 (0.013)	–	–
Volume of deposits of individuals in banks	–	–	0.97 (0.08)	11.96 (0)
Postal and courier services	–	–	1.78 (0.31)	5.72 (0)
Migration growth	–	–	4509.8 (1087.95)	4.14 (0)
Property purchase expenses	–	–	–109168.44 (48291.51)	–2.26 (0.03)
-2 Log- credibility	441		5835	
Akaike information criterion (AIC)	453		5865	
Hurwicz – Cai criterion (AICC)	469.8		5868	
Bozdogan criterion (CAIC)	461.9		5929	
Bayesian information criterion (BIC)	455.9		5914	

Source: Compiled by the authors.

banking services and financial literacy of the population is increasing.

There is a low level of correlation between the volume of investment in ICT in different fields and financial indicators of welfare — average monthly wages, retail trade turnover, GDP per capita — which is due to the direction of investment, and which is not to increase the number of services, but to improve their availability and quality. The purchasing power of the population in most regions remained unchanged during the period under review, and investments in digitization did not affect the growth of the people's monetary income.

To assess the impact of factors on the welfare of the population, a model of panel data with fixed effects (objects — 85 regions of Russia) based on a step-by-step selection of factors to determine the significance of the model was developed (*Table 3*).

The models are compared by quality level: the lower the value of the criteria (AIC, AICC, CAIC, BIC), the more adequate the model is to assess the spatial-time relationship between variables. The resulting values of significance *p* indicate the high significance of coefficients in models. The third model, which describes the return of investments in the digitalization of the services sector, expressed in increasing the provision of digital infrastructure (personal computers), the financial capacity of the population of the region to accumulate funds, the increase in the volume of health services, is the lowest in statistical estimates. At the same time, the inverse relationship of investment is observed with the volume of communications services that are decreasing in those regions where the investment in the digitalization of service organizations is higher, as well as with the number of registered diseases.

The first model demonstrates the relationship between savings growth, the population (service consumers), postal services, telecommunications, and investments in service organizations' digitalization. In the second model, in addition to the factors listed, there is the reverse effect of investments on the number of teaching staff, which can indicate the replacement of labor with digital capital in the field of education. At the same time, investments in the digitization of service organizations are noted in regions with migration and natural growth, i.e. with a high level of welfare. Since there is differentiation between regions, models with high and medium quality of life have been developed, including most of the regions (*Table 4*).

In terms of quality, the first model (*Table 4*) has the best statistical indicators, indicating the high correlation of investment in digitalization in economically prosperous regions with indicators of computer equipment, the volume of health services, and the number of illnesses identified (reverse dependence). For regions with average quality of life, the inflow of investment in digitalization explains the increased savings capacity of the population and the decreased expenditure on the purchase of real estate, the volume of postal services, and the increase in migration. More developed regions provide more favorable employment conditions; therefore, the introduction of distant employment may slow the population flow from areas that are less developed. On the other hand, distant employment can increase the burden on workers and reduce their quality of life. The services sector's digitalization makes public goods readily available and satisfies social requirements, resulting in improved living and working conditions.

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ABOUT THE AUTHORS

Vilena A. Yakimova — Cand. Sci. (Econ.), Assoc. Prof., Department of Finance, Amur State University, Blagoveshchensk, Russia
https://orcid.org/0000-0001-5866-5652
Corresponding author:
vilena_yakimova@mail.ru

Sergey V. Khmura — graduate student, Amur State University, Blagoveshchensk, Russia
https://orcid.org/0000-0003-0704-8755
sergey.khmura@gmail.com

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