Advances in Economics, Business and Management Research, volume 81
1st International Scientific Conference "Modern Management Trends and the Digital Economy: from Regional Development to Global Economic Growth" (MTDE 2019)

Econometric analysis of the Russian regions' digital inequality

Shabardina T.V.
Master's Degree student
Chelyabinsk State University
Chelyabinsk, Russian Federation

***Abstract* — This article covers the issues of digital development of Russian regions, since information technologies today are one of the determining factors of economic and social prosperity of the country as a whole and of a particular region in particular. The previously developed digitalization index is calculated, based on which the indicators of the regions for the period from 2014 to 2017 are analyzed, showing the dynamics of development of each region in the informational context. The factors included in the index and the degree of influence they have to regional digitalization were also assessed. On the basis of the index, a cluster analysis of the regions was carried out, which allows to define typical groups the regions are distributed depending on the level of digital development.**

Keywords* — *digital inequality, digitalization, digital development, clustering, index.

I. INTRODUCTION

The implementation of the innovation policy in Russia is aimed to stimulating the socio-economic development of the country, forming of sustainable growth, the transition to a new stage of economic development and the creation of the digital society infrastructure. The key mechanism of these events is to increase the role of scientific and technical activities, the development of the IT industry and related industries, as well as the Internet infrastructure. Therefore, the current activities of the state and business are aimed at the development of the digital economy: ensuring favorable legal conditions for domestic IT companies, the organization of technology parks in the field of high technologies, the development of e-government, the development of mobile communications and broadband access, an increase in the output of specialists in the digital economy, etc. All these and other factors in varying degrees affect the level of digitalization of each region of the country. In this regard, there may be a large gap in terms of information development, which would entail an increase in regional digital inequality.

II. THE EFFECTIVENESS OF STATE POLICY IN THE FIELD OF REGIONS' INFORMATIZATION

According to the Global Information Technologies report, the Russian Federation ranks 41st in readiness for the digital economy (Network Readiness Index NRI) and is in the middle of the second group of countries (catching up) in the Digital Economy and Society Index (I-DESI) [2].

An increasing number Russian citizens recognize the need for possession of digital competencies, but the indicators for the use of personal computers and the Internet information and telecommunications network are still lower in the country than in Europe. There is a gap in digital skills between different population groups (in 2018, the share of people with digital skills was only 26 percent according to the results of the international PIAAC survey).

The use of digital technologies in the education system is expanding, but the volume of specialized training and the compliance of educational programs with the needs of the digital economy are insufficient.

Russia's low position in the talent attraction rating of The Global Talent Competitiveness Index [1] (53rd position in 2018) also characterizes low human potential in the development of digital technologies in the economy, which determines the need to attract qualified foreign specialists and support talented schoolchildren and students in the field of mathematics and computer science.

The existing regulatory environment does not meet the tasks of giving flexibility to the regulation of public relations, their readiness to perceive the constantly changing technological context. Despite systemic steps to improve the business climate, there are still a large number of gaps in the legislation, administrative barriers to the development of a business based on the use of information technology, and work with data. In general, the development of a mechanism for managing changes in the digital economy is required, allowing for timely adaptation of the regulatory framework to the challenges of digital development.

The need to accelerate the introduction of digital technologies in the economy and the social sphere creates new challenges for research and development in the field of the digital economy, and requires the creation of a research and development management system that coordinates the efforts of the state, companies, educational institutions of higher education and scientific organizations.

Ensuring the sustainability and safety of the Russian digital infrastructure requires the organization and construction of a system of data processing and storage centers in the country, taking into account the possibilities of building the export potential of these services, contributing to the development and competitiveness of the Russian digital economy.

The development of the economy and social sphere digitalization requires the strengthening of security measures for the information environment. The current level of public use the information protection tools, ensuring the routing of network traffic in the Russian segment of the Internet information and telecommunications network, the use of national developments and technologies in software is insufficient and requires additional measures to ensure the

Copyright © 2019, the Authors. Published by Atlantis Press.
This is an open access article under the CC BY-NC license (http://creativecommons.org/licenses/by-nc/4.0/).

protection of the rights and interests of individuals, businesses and the state in cyberspace.

The results achieved in previous years in terms of increasing accessibility, manufacturability and reducing administrative barriers in the provision of public services and public administration should be provided with successive measures that will allow a new level of state interaction with citizens and business entities to be achieved by translating such interaction into digital, "proactive" and remote mode. In order to develop a digital economy based on the use of data, it is necessary through the introduction of digital technologies and digital platforms to ensure the reduction of time and administrative costs in the provision of state and municipal services, the implementation of control and supervisory functions, the functioning of state and municipal bodies.

In order to implement the provisions of the "May decree" of the President of Russia [4], the main areas of activity of the Government of the Russian Federation for implementing breakthrough scientific, technological and socio-economic development, including the development of the digital economy, are:

- increasing digital literacy;
- promotion of the development of digital innovation support services;
- implementation of innovative development programs and digital transformation strategies of leading companies with state participation;
- ensuring accelerated introduction of digital technologies in the economy and social sphere;
- the creation of a system of digital economy legal regulation based on a flexible approach to each sphere, as well as the introduction of civilian circulation based on digital technologies;
- the creation of a global competitive infrastructure for the transfer, processing and storage of data mainly based on domestic developments;
- providing training of highly qualified personnel;
- ensuring information security based on national developments in the transfer, processing and storage of data, guaranteeing the protection of the interests of the individual, business and government;
- creation of end-to-end digital technologies mainly based on national developments;
- introduction of digital technologies and platform solutions in the areas of public administration and the provision of public services, including in the interests of the population and small and medium-sized businesses, including individual entrepreneurs;
- optimization and standardization of the processes of providing state and municipal services, functions and services; introduction of new principles for the provision of state and municipal services aimed at maximum convenience for citizens and organizations, proactivity, extraterritoriality and multi-channel provision of them;
- creation of a single platform on the principle of "one window" in order to provide citizens with a single access point for interaction with the state.
- measures for the introduction of digital technologies and platform solutions ("digitalization") into the practical activities of state bodies of the federal, sectoral and regional levels;
- ensuring the routing of network traffic of the Internet information and telecommunications network in the Russian Federation.

Internet traffic and telecommunications in the Russian Federation.

- "Regulation of the digital environment"
- "Information Infrastructure";
- "Personnel for the digital economy";
- "Information Security";
- "Digital Technologies";
- "Digital Public Administration".

According to experts [6], almost all activities included at the current version of the draft document are at the federal level, and therefore the role of the regions in the digitalization of the economy is incomprehensible.

The possibility of transition to a digital economy directly depends on what conditions for the application of digital technologies are created in a specific subject of the Russian Federation. In this regard, in the regions, based on their needs, conditions and resources, it is necessary to form the goals of using digital technologies and incorporate them into regional socio-economic development programs.

In order to motivate authorities to increase the level of the region digitization, authorities and businesses need to adjust support measures for entrepreneurs, including SMEs, taking into account the providing of subsidies (in the form of grants) to legal entities for the implementation of projects related to the development and implementation of breakthrough information technologies that will develop effective IT solutions in the most significant areas for the region.

In addition, according to experts, it is advisable to draw attention to new opportunities to attract funds, which appeared due to the fact that information technology can now be subject to concession agreements and agreements on public-private partnership.

Thus, at the regional level it is necessary to use all existing at the present stage opportunities for the introduction of digital technologies:

- implement solutions approved in other regions;
- use all available sources of funding;
- integrate already created digital platforms into new projects;
- provide training for people with digital knowledge.

At the same time, it should be noted that the implementation of large-scale technological projects without creating a unified system for managing the digital transformation of the regional economy at the level of each entity is impossible.

III. The Basis of the Study

This article is a direct continuation of the previously reviewed by the author of the study [6]. It reviewed the approaches of various authors and research centers to the study and digital potential assessment of a region or its integral part. The study highlighted the main factors that to some extent influence the formation of digital development in the region, and based on these indicators, a system of indicators and an index were created, allowing to assess the

level of information potential of the region. In the course of the study, such methods as scientific generalization, system analysis were used, and in this study economic, mathematical and statistical methods were used.

IV. CALCULATION OF THE DIGITALIZATION INDEX OF THE REGIONS OF RUSSIA

To assess the influence of factors on the level of digitization of the regions, within the framework of the study, an array was formed, which represents panel data on the variables presented in the previous study. The study period: 2014-2017 The choice of this period is due to the availability of complete information on the established system of indicators, in particular, the following factors:

- the accession of the Republic of Crimea and the city of Sevastopol and their separation into separate regional units. Thus, information on these regions until 2014 is not available;
- lack of data for 2018. The publication of statistical data on the studied indicators by the Federal State Statistics Service is carried out in April-May of the year following the reporting one.

In order to adequately present the source data and bring them to a comparable form, within the study, a linear rationing "minimax" was carried out, according to the results of which the scorecard is reduced to the form when the values of each variable are in the range from 0 to 1. Rationing of indicators in the framework of the study was carried out by means of an Excel spreadsheet processor. For example, the rationing of the indicator of investments in the fixed capital of enterprises of the telecommunications industry in 2014 in the Chelyabinsk region was carried out as follows (1):

$$\tilde{x} = \frac{3398{,}4-54{,}7}{49780{,}5-54{,}7} = 0{,}0672 \text{where} \qquad (1)$$

- 2370 - the current value of the indicator (Chelyabinsk region-2014);
- 54.7 - the minimum value of the indicator for 2014 (year Sevastopol);
- 49780.5 - the maximum value of the indicator for 2014 (Moscow).

The calculation of the sub-indices I_{transf} and $I_{transact}$ was carried out taking into account the analysis of the information sources about the significance of each indicator with the subsequent formation of a weight system for each of the indicators, which are listed in Table 1.

TABLE I. WEIGHTS COEFFICIENTS FOR INDICATORS' SYSTEM

Indicator's Index	**Indicator**	**Weights**
	Transformational factors	
Financial block		
n_1	fixed capital investment to communication sphere	0.094
n_2	organizations' costs for training ICT staff	0.0943
n_3	expenses of the consolidated budgets of subjects of the Russian Federation on transport, communications and computer science	0.0947
n_4	research and development costs	0.0226
Technical unit		
n_5	number of personal computers in regional organizations	0.0992
n_6	volume of communication services rendered to the population per citizen	0.043
n_7	the number of active subscribers of fixed and mobile broadband Internet access	0.1123
n_8	households with a personal computer and Internet access	0.114
n_9	number of organizations having WEB-sites	0.1111
Personnel block		
n_{10}	average annual number of people employed in information and communication	0.0728
n_{11}	share of working age population	0.0302
n_{12}	the part of people employed in the economy, with higher education	0.0321
n_{13}	the proportion of people employed in the economy, working in education	0.0182
Science unit		
n_{14}	part of students enrolled in undergraduate, specialist, and master's programs in the total population	0.0101
n_{15}	number of organizations performing research and development	0.0111
n_{16}	issuance of patent applications	0.0102
n_{17}	graduate bachelors, specialists and masters	0.0136
n_{18}	number of state and municipal educational institutions of higher education	0.0165
	Total:	1
	Transactional factors	
Organizational unit		
n_{19}	part of organizations using software	0.143
n_{20}	number of organizations using the Internet	0.1383
n_{21}	availability of a structural unit for informatization in the Administration of a constituent entity of the Russian Federation	0.1164
Institutional unit		
n_{22}	availability of the Concept and programs of informatization of the region	0.0956
n_{23}	availability of legislation on informatization of the region	0.0892
Information block		
n_{24}	number of shared sites with Internet access	0.1152
n_{25}	library fund	0.0753
n_{26}	issue of newspapers per 1000 population	0.0672
Innovative block		
n_{27}	number of enterprises involved in business incubators, technology transfer centers	0.0428
n_{28}	volume of innovative goods, works, services	0.0533
n_{29}	the proportion of innovative enterprises in the structure of the regional economy	0.0637
Total:		1

Based on the specified weights in the framework of the study, the tools of the spreadsheet processor Excel were used to calculate the indexes of I_{transf} and $I_{transac}$ in the study period of 2014-2017. An example of the calculation of the $I_{transac}$ sub-index for the Chelyabinsk region in 2014 is shown below.

According to the calculations, the maximum indices of

$$I_{\text{трансакц}} = 0{,}0982n_{19} + 0{,}095n_{20} + 0{,}1164n_{21} + 0{,}0956n_{22} + 0{,}0892n_{23} + 0{,}0127n_{24} + 0{,}0204n_{25} + 0{,}0220n_{26} + 0{,}0119n_{27} + 0{,}0049n_{28} + 0{,}0178n_{29} = 0{,}5841 \quad (2)$$

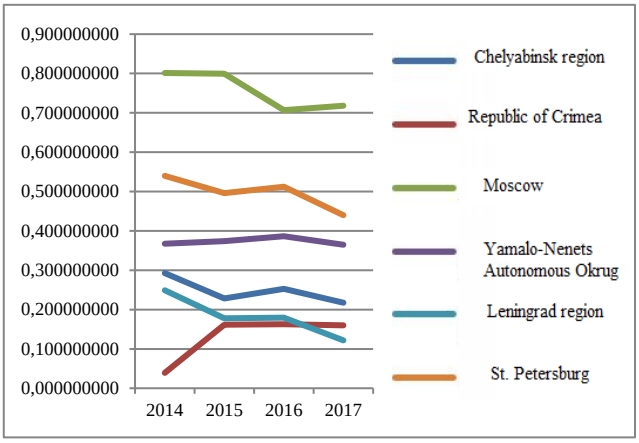

Fig. 1 Dynamics of the subindex I_{transf}

indices in the period under study are characterized by indicators of Moscow (Figure 1). At the same time, it should be noted that the I_{transf} and $I_{transac}$ indices show a decrease by 2017 compared to the 2014 indicator. In the studied period, indicators of the Republic of Crimea (2014), the Nenets Autonomous District (2015, 2016) and the Leningrad Region (2017) are characterized by the minimum values of the index reflecting the transformation of the resources of I_{transf}. It should be noted a significant positive dynamics of this index in the Republic of Crimea in 2017. (+0.12093) and a significant decline in the Leningrad region (-0.12729). The minimum values of the transaction factor are characterized by indicators of indices of the Ivanovo region (2014, 2017) and the Chechen Republic (2015, 2016) (Fig. 2).

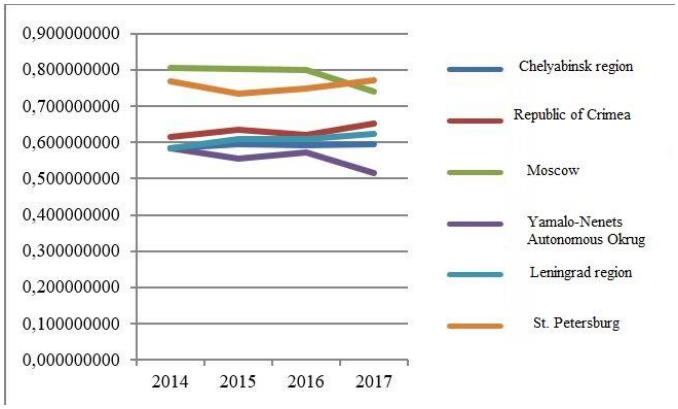

Fig. 2. Dynamics of the $I_{transac}$ sub-index

In view of the fact that the resource component is the basis for the development of any phenomenon, process or object, then for the I_{transf} index, in the author's opinion, the weighting factor should be taken equal to $\propto = 0.65$, while for the index of transaction factors reflecting elements relations forming relations, the weight coefficient is assumed to be $\beta = 0.35$.

In addition, the weights for the sub-indices within the framework of the study are determined by the results of analytical materials collected by the Institute for Statistical Studies and Economics of Knowledge (ISSEK) of the National Research University "Higher School of Economics" [3].

An example of the calculation of the digitalization index for the Chelyabinsk region in 2014 is presented below.

$$I = 0{,}65 \cdot 0{,}2926 + 0{,}35 \cdot 0{,}5841 = 0{,}3946$$

An example of the calculation of the digitalization index for the Chelyabinsk region in 2014 is presented below. Moscow, St. Petersburg, Kamchatka Territory and the Chukotka Autonomous Region), with an average value (Chelyabinsk and Novgorod regions) and with a minimum value (Sevastopol, Nentsky Autonomous District) (Fig. 3).

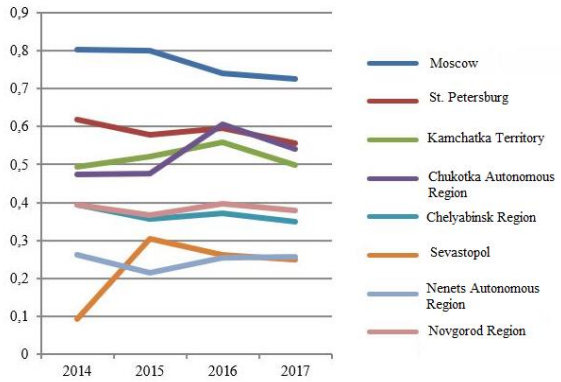

Fig. 3 Dynamics of the digitalization index

The high indices of the digitalization index for the Kamchatka Territory and the Chukotka Autonomous Region are primarily due to the high values of such indicators as:

- expenses of the consolidated budgets of the subjects of the Russian Federation for transport, communications and computer science;
- the number of active subscribers of fixed and mobile broadband Internet access;
- households with a personal computer and Internet access.

In general, during the period under study, there is a movement of the index values to the average value, which may indicate a smoothing of the digital inequality among the regions of Russia.

V. Assessment of the Influence of Factors on the Level of Digitization of Russian Regions

In order to assess the influence of factors on the index of the digitalization index, a correlation analysis and model building were carried out as part of the study. To this end, as an endogenous variable, an index of digitalization index was obtained, obtained from the results of calculations, and as exogenous variables - a system of transformational and

transactional factors formed during the study. For building models and analysis in the work was used statistical package SPSS.

At the initial stage, a selection was made of factors that are characterized by the strongest relationship with the endogenous variable. For this, a matrix of paired correlation coefficients was used (Table 2).

TABLE II.TABLE II. PEARSON CORRELATION COEFFICIENTS

Indicator	AND
n1	0.657
H2	0.608
n4	0.654
n10	0.654
n14	0.635
n15	0.667
n16	0.65
n17	0.639
n18	0.655
n25	0.189

According to the results of constructing the matrix of paired correlation coefficients, it can be concluded that only the “Library Fund” indicator has an insignificant effect on the digitalization index in the regions of Russia. In addition, the following factors are characterized by a high level of correlation relationship with other exogenous variables:

- fixed investment in the communications industry;
- costs of organizations for training ICT staff;
- research and development costs;
- the average annual number of people employed in the field of information and communications;
- the proportion of students enrolled in undergraduate, specialist, and master's programs in the total population;
- number of organizations performing research and development;
- issuance of patent applications;
- graduation of bachelors, specialists and masters;
- number of state and municipal educational organizations of higher education.

Thus, it is advisable to carry out the construction of a regression model by eliminating the indicated exogenous variables. The results are presented in Fig. 4.

Model Summary

Model	R	R-square	Adjusted R-squared	Standard error of assessment
1	,981[a]	,963	,952	,0161710982

a. Predictors (constant) n29, n11, n22, n25, n24, n20, n26, n9, n12, n5, n21, n23, n28, n7, n8, n13, n3, n6, n27

ANOVA[a]

Model		Sum of squares	st. sv.	Average square	F	Significance
1	Регрессия	,438	19	,023	88,253	,000[b]
	Остаток	,017	65	,000		
	Всего	,455	84			

a. Dependent variable I

b. Predictors (constant) n29, n11, n22, n25, n24, n20, n26, n9, n12, n5, n21, n23, n28, n7, n8, n13, n3, n6, n27

Coefficients[a]

Model		Non-standardized coefficients		standardized coefficients		Significance
		B	Standard error of assessment	Beta	T	
1	(Константа)	-,003	,015		-,177	,860
	n3	,045	,021	,095	2,203	,031
	n5	,125	,018	,229	6,858	,000
	n6	,139	,025	,297	5,536	,000
	n7	,008	,018	,018	,421	,675
	n8	,069	,013	,176	5,220	,000
	n9	,055	,012	,135	4,443	,000
	n11	,004	,019	,009	,200	,842
	n12	,020	,012	,052	1,737	,087
	n13	,025	,020	,054	1,265	,210
	n20	,107	,009	,307	11,511	,000
	n21	,040	,007	,160	5,457	,000
	n22	,034	,009	,119	3,840	,000
	n23	,047	,013	,117	3,636	,001
	n24	,015	,018	,025	,839	,4_5
	n25	,002	,011	,006	,195	,846
	n26	,037	,012	,096	3,061	,003
	n27	-,026	,023	-,064	-1,147	,256
	n28	,050	,012	,134	4,118	,000
	n29	,057	,025	,143	2,339	,022

a. Dependent variable I

Fig. 4. Indicator Regression Model № 1

Next, an assessment was made of the quality of the model in general and of the coefficients of the equation, in particular.

Analysis of the model showed that the model is characterized by a rather high index of determination (R^2 = 0.963). In addition, the calculated value of the F-criterion significantly exceeds the critical indicator (F_{calc} = 88.253> F_{crit} = 1.54).

Analysis of p-values and t-statistics allow us to conclude that only coefficients are statistically significant with the following variables:

- n_3 - expenses of the consolidated budgets of the subjects of the Russian Federation for transport, communications and computer science;
- n_5 is the number of personal computers in organizations in the region;
- n_6 is the volume of communication services rendered to the population per citizen;
- n_8 — households with a personal computer and Internet access;
- n_9 - the number of organizations having WEB-sites;
- n_{20} is the number of organizations using the Internet;
- n_{21} - the presence of a structural unit for informatization in the Administration of the subject of the Russian Federation;

- n_{22}- availability of the Concept and programs of informatization of the region;
- n_{23} - the presence of legislation on informatization of the region;
- n_{26} - the release of newspapers per 1000 population;
- n_{28} is the volume of innovative goods, works, services.

Next, the regression model No. 2 was constructed taking into account the identified features (Fig. 5).

Model Summary

Model	R	R-square	Adjusted R-squared	Standard error of assessment
1	,976[a]	,953	,946	,0171007436

a. Predictors (constant) n28, n21, n3, n8, n20, n5, n9, n22, n23, n26, n6

ANOVA[a]

Model		Sum of squares	st. sv.	Average square	F	Significance
1	Regression	,434	11	,039	134,961	,000[b]
	Residual	,021	73	,000		
	Total	,455	84			

a. Dependent variable I

b. Predictors (constant) n28, n21, n3, n8, n20, n5, n9, n22, n23, n26, n6

Coefficients [a]

Model		Non-standardized coefficients		standardized coefficients		Significance
		B	Standard error	Beta	T	
1	(Константа)	,004	,014		,266	,791
	n3	,081	,015	,170	5,382	,000
	n5	,132	,018	,241	7,453	,000
	n6	,159	,017	,340	9,118	,000
	n8	,057	,011	,145	5,023	,000
	n9	,065	,011	,161	5,682	,000
	n20	,111	,009	,318	11,885	,000
	n21	,039	,007	,156	5,277	,000
	n22	,032	,009	,112	3,585	,001
	n23	,057	,012	,143	4,711	,000
	n26	,040	,012	,101	3,249	,002
	n28	,062	,011	,167	5,624	,000

a. Dependent variable I

Fig. 5. Next, the regression model No. 2 was constructed (Fig. 5).

Analysis of the results of building the model allows to conclude that it is of statistical significance ($R^2 = 0.953$, $F_{calc} = 134.961 > F_{crit} = 1.68$). All model coefficients are also statistically significant.

Thus, according to the results of the evaluation of the influence of factors on the digitalization index, the regression equation shown below

$$I = 0{,}04 + 0{,}081n_3 + 0{,}132n_5 + 0{,}159n_6 + 0{,}057n_8 + 0{,}065n_9 + 0{,}111n_{20} + 0{,}039n_{21} + 0{,}032n_{22} + 0{,}057n_{23} + 0{,}04n_{26} + 0{,}062n_{28} \quad (3)$$

As the analysis shows, the index of the number of organizations using the Internet, the growth of which leads to an increase in the index by 0.111, has the greatest impact on the digitalization index at the regional level.

VI. Cluster analysis of Russian regions in terms of digitalization

To determine the groups of regions by the level of digitalization development and which of these groups the Chelyabinsk region belongs to, cluster analysis was performed. For the clustering of regions, we used the Ward method, which is based on the methods of analysis of variance, as well as the Euclidean distance, which is the geometric distance in multidimensional space. First, the cluster dendrogram was built, and data agglomeration was carried out, allowing to view each clustering step (Fig. 6)

Stage	Merged cluster	
	Cluster 1	Cluster 2
1	38	43
2	28	31
3	26	44
4	69	81
5	42	58
6	32	46

Fig. 6 Fragment of data agglomeration

An analysis of the agglomeration of data shows that in the first step the unification of the Republic of Dagestan (38) and the Chechen Republic (49) took place. Indicators of the digitalization index of these regions are very close in values, minimally distant from each other. In the future, these regions no longer appear, indicating a hit in one cluster.

In the second step, the Pskov Region (28) and the Republic of Kalmykia (31) were merged. Indicators of the digitalization index of these regions are also very close in terms of values. Further, the Murmansk region (26) and the Stavropol Territory (44), the Altai Territory (69), the Amur Region (81), etc.

Thus, according to the results of cluster analysis, 4 regional clusters have been identified, the distribution of regions for which is presented in Table 3.

TABLE III.TABLE III. Distribution of regions by clusters in terms of digitalization index

Cluster 1	Cluster 2	Cluster 3	Cluster 4
Belgorod region	Bryansk region	Voronezh region	Moscow
Kursk region	Vladimir region	Kaluga region	St. Petersburg
Lipetsk region	Ivanovo region	Moscow region	Kamchatka Krai
Smolensk region	Kostroma region	Ryazan region	Chukotka Autonomous District
Yaroslavl region	Oryol region	Tambov region	
Arkhangelsk region	Tver region	Rep. Karelia	
Vologda region	Tula region	Kaliningrad region	
Pskov region	Rep. Komi	Murmansk region	
Rep. Adygea	Nenets Autonomous District	Novgorod region	
Rep. Kalmykia	Leningrad region.	Krasnodar region	
Rep. Crimea	Volgograd region	Rostov region	
Astrakhan region	Sevastopol	Rep. Ingushetia	
Kabardino-Balkar Republic	Rep. Dagestan	Stavropol region	
Karachay-Cherkess Rep.	Rep. North Ossetia Alania	Rep. Bashkortostan	
Rep. Mari El Republic	Chechen Republic	Rep. Tatarstan	
Udmurt Rep.	Rep. Mordovia	Chuvash Rep.	
Kirov region	Ulyanovsk region	Perm region	

Orenburg region	Kurgan region	Nizhny Novgorod region	
Saratov region	Rep. Buryatia	Penza region	
Chelyabinsk region	Kemerovo region.	Samara region	
Rep. Altai		Sverdlovsk region.	
Rep. Tyva		Khanty-Mansiysk Autonomous Okrug - Ugra	
Rep. Khakassia		Yamalo-Nenets Autonomous District	
Altai region		Tyumen region	
Transbaikal region		Krasnoyarsk Region	
Irkutsk region		Novosibirsk region	
Omsk region		Rep. Sakha (Yakutia)	
Tomsk region		Primorsky region	
Amur region		Khabarovsk region	
		Magadan region	
		Sakhalin region	
		Jewish Autonomous Region	

The optimal number of clusters can be judged by the indicators of the "Coefficients" column in the table of data agglomeration. At the stage where the measure of the distance between two clusters increases in steps, the process of combining into new clusters must be stopped. The optimal is the number of clusters, equal to the difference in the number of observations (in this case 84) and the number of steps, after which the coefficient increases in steps (in this case at step 80). Thus, the optimal number of clusters is 4.

The analysis shows that the megacities of Moscow, St. Petersburg, the Kamchatka Territory and the Chukotka Autonomous Region are highlighted in a separate cluster (cluster 4), which demonstrate the highest rates of the digitalization index (0.726, 0.556, 0.499 and 0.542 in 2017, respectively) .

The most numerous cluster is cluster 3, into which 32 regions of Russia are grouped. Somewhat smaller (29) regions were included in cluster 1. Cluster 2 contains 20 regions of Russia. In Fig. 7 shows the average values of the digitalization index for the formed clusters.

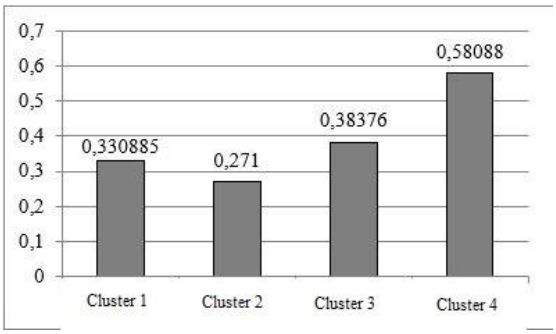

Fig. 7 Average values of the index of digitalization by clusters.

Thus, we can conclude that clusters No. 1 and No. 3 are moderately stable, cluster No. 4 is the leader, and cluster No. 2 is characterized by a less expressive pace of development (outsider).

VII. Conclusion

Thus, having performed an in-depth value analysis of the indicators for each region of Russia, we managed to identify the dynamics of regional digitalization, determine the factors have the greatest influence on the region's place in the overall rating by the level of digitalization development, and also single out the leading, catching up and lagging regions. This study allows to consider in detail the development of each region and determine its potential in terms of dissemination and use of information technology. The calculation of the digitalization index made it possible to see changes in the development of the regions over the past 5 years, among which smoothing of the digital inequality and among the regions and the movement of the index value to the national average is clearly reflected.

References

[1] "The Global Talent Competitiveness Index" [Electronic resource]. - Access mode: https://www.insead.edu/sites/default/files/assets/dept/globalindices/docs/GTCI-2018-report.pdf

[2] Network readiness index NRI [Electronic resource]. - Access mode: https://gtmarket.ru/ratings/networked-readiness-index/networked-readiness-index-info

[3] Institute of Statistical Studies and Economics of Knowledge [Electronic resource]. - Access mode: https://issek.hse.ru/

[4] Decree of the President of the Russian Federation of May 7, 2018 No. 204 "On the national goals and strategic objectives of the development of the Russian Federation for the period up to 2024" [Electronic resource]. - Access mode: http://publication.pravo.gov.ru/Document/View/0001201805070038

[5] Order of the Government of the Russian Federation of July 28, 2017 N 1632-p "On Approval of the Program" Digital Economy of the Russian Federation "[Electronic resource]. - Access mode: http://base.garant.ru/71734878/38127a69cf2aace7e6dc686e8a4b9579/#block_1000

[6] T.V. Shabardina, Developing a Conceptual Model for Evaluating the Digital Inequality of Regional Economic Systems, Journal "Competitiveness in a Global World: economy, science, technology "(2019) 8-15.

[7] The expert community is concerned about the lack of a regional component in the Digital Economy program [Electronic resource]. - Access mode: http://www.garant.ru/news/1230794/