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Assessment of the Development of the Social Infrastructure of Russian Regions and its Impact on Demographic Processes

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ABSTRACT

The subject of the study is the demographic development of the regions of the Russian Federation. The dynamics of the key indicators at the federal and local levels define **the relevance** of the issue. State financial resources aimed at implementing measures to stimulate fertility growth and increase life expectancy often fall flat. **The aim** of the study is to determine the impact of the elements of the regional social infrastructure on demographic processes. The research **methods** follow from assessing particular parameters of social infrastructure development, and Rosstat statistical data for 2010–2018, as well as data by the Ministry of Finance of the Russian Federation. The authors carried out a structural, correlation data analysis, formed a complex of regression equations, and used the methods of normalization and ranking of indicators. The study **resulted** in an approach to the sequential convolution of particular indicators, which characterize the development of individual areas of social infrastructure, into integrated indicators for the considered areas; the following determination of the integral indicator of the development of regional social infrastructure as a whole. The authors calculated integral indicators of social infrastructure development for the identified areas in the constituent entities of the Russian Federation. **The scientific novelty** of the approach consists in developing a set of integrated indicators, based on the assessment of social infrastructure development aimed at the indicators of natural and migration movement of the population. The authors **concluded** that the development of public policy measures in the field of demographic development, as well as an appropriate financial base, should consider the impact of social infrastructure elements on the components of demographic development. The results can be useful for building a comprehensive model of socio-economic development of the Russian regions.

Keywords: social infrastructure; public funding; demographic processes; correlation analysis; standardization of indicators; provision of services; regions of Russia

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INTRODUCTION

According to the norms of Russian law, "The Russian Federation is a social State whose policy is aimed at creating conditions for a worthy life and a free development of man"[1]. It is not surprising that about 60% of consolidated budget is spent on the development of the social sphere, including such areas as healthcare, education, and culture. In support of this, the overwhelming majority of national projects implemented in accordance with Presidential Decree No. 204 of May 7, 2018, "On National Goals and Strategic Tasks of the Development of the Russian Federation for the Period until 2024" are socially-oriented. At the same time, one of the most important is the national project Demography, whose costs amounted to 498.3 billion roubles as of January 1, 2020 (i.e., about 31.1% of all costs for national projects)[2].

Most other projects are also directly or indirectly aimed at improving the demographic situation in the country [including the national project Healthcare (157.1 billion roubles)]. However, despite the measures taken, in 2019, even the migration flow from abroad could not compensate for the natural decline in the country's population. According to Rosstat estimates, the total population decline is about 35.6 thousand people[3] for the second year in a row. Moreover, most researchers predict worsening of the situation.

Despite the country's budget surplus and measures taken (including those announced in the message of the President of the Russian Federation on January 15, 2020), financial resources that could be used to improve the demographic situation are limited. In this regard, to develop public policy measures in this field, it is necessary to identify the most significant factors that have a decisive influence on demographic processes.

The analysis shows that the majority of researchers consider various elements of social infrastructure, created both from public and private funds, as these factors [1]. However, the question of a complex assessment of the development of the social infrastructure of the region from the standpoint of its impact on demographic processes has been studied insufficiently. A similar situation determined the relevance of the study and the results obtained.

ELEMENTS OF SOCIAL INFRASTRUCTURE

The problem of studying the impact of social infrastructure on the demographic development of territorial systems is largely due to the inconsistency of the object of study. On the one hand, the current list of works devoted to the analysis of the structure and development trends of social infrastructure both in the Russian Federation [2] and abroad [3–5] is rather long. However, it is largely due to this fact that there are many approaches to the very concept of "social infrastructure" and, as a result, other issues related to it — structure, development, need for it, and interconnection with other components of social life.

In this study, we do not aim to conduct a comparative analysis of existing approaches to this definition, and therefore, we will consider just one of them. Social infrastructure is a complex of objects (enterprises, institutions, organizations and structures) that provide the environments of public production and the life of the population, the formation of a physically and intellectually developed, social-minded individual [6]. Social infrastructure includes objects of healthcare, education, cultural and leisure sphere, housing and communal services, trade and services, etc.

[1] The Constitution of the Russian Federation (adopted by a nationwide vote on 12.12.1993).

[2] Preliminary data on federal budget expenditure execution for the implementation of national projects as of January 1, 2020. Ministry of Finance of the Russian Federation. URL: https://www.minfin.ru/ru/press-center/?id_4=36929-predvaritelnye_dannye_ob_ispolnenii_raskhodov_federalnogo_byudzheta_na_ryealizatsiyu_natsionalnykh_proektov_na_1_yanvarya_2020_goda (accessed on 05.02.2020).

[3] Preliminary estimate of the resident population as of January 1, 2020 and an average of 2019. Rosstat. URL: https://www.gks.ru/folder/12781 (accessed on 05.02.2020).

In 2018, according to Rosstat[4], more than 60% of the consolidated budget of the Russian Federation was allocated to social and cultural events, including education (42.2% of this sphere), healthcare (13.3% of this sphere) and social policy (33.8% of this sphere). In addition, another 10.2% was aimed at supporting the housing and communal services sector. In the regional context, the share of budget expenses on social and cultural events was less than 40% only in two regions. They include the Chukotka Autonomous region (which at the same time is leading in expenses on housing and communal services) and the Kaliningrad region (where a significant increase in expenses on the national economy has been since 2016). In these regions, the value of the indicator was 32.8 and 30.1%, respectively. In 21 constituent entities of the Russian Federation, its value is 70% (the Republic of Chechnya is leading with 79.0%). Thus, we can state that expenses on social infrastructure are decisive in terms of establishing the country's financial policy.

Developing each of these spheres in the region can be characterized by many indicators. In this regard, the research on this topic provide various approaches to determining the number and composition of the indicators and their grouping. For example, the World Bank is assessing social infrastructure by the following indicators [7]:

1. Number of hospital beds.
2. Number of doctors.
3. Number of primary school teachers.
4. Number of secondary school teachers.

However, in most cases, a longer list of indicators is used. In particular, the reviews are given in works [8, 9]. In this regard, it seems appropriate to move from considering particular indicators to some integral parameters of the development of a particular sphere. In our opinion, to solve this problem, we should consider indicators characterizing the development of healthcare, the cultural and leisure sphere, housing and communal infrastructure, education, and the trade and services sphere. At the same time, we should consider that, on the one hand, the change in funding these areas influences the level of their development. On the other hand, for the final consumer of services, only the actual state of these sectors makes sense. Moreover, using purely financial indicators would require using various deflators to make it possible to compare the indicators. While physical indicators do not have this drawback.

Considering the healthcare sector, we should note that the Decree of the President of the Russian Federation No. 204, which describes the tasks stipulated by the national project in the field of healthcare, implies focusing on eliminating staff shortages in medical organizations, reducing the waiting time in medical organizations, optimization of the work of medical organizations. These issues are also considered by foreign studies [10].

We suggest considering the provision of medical services as a development indicator of social infrastructure in this sphere. It is a synthetic indicator that includes such parameters as the number of hospital beds, the capacity of outpatient clinics, the number of doctors of all specialties, and the number of nursing staff. Moreover, we would to include the morbidity rate per 1000 people to assess the effectiveness of the available options. All indicators are considered not as absolute but as specific (i.e. per capita).

It should be noted that the capacity of outpatient organizations is largely determined by the availability of appropriate staff. This raises the question of the actual duplication of indicators and the excessive number of the considered parameters. We conducted a correlation analysis to test this hypothesis. *Table 1* presents the obtained results.[5]

[4] Regions of Russia. Socio-economic indicators. 2019. Rosstat. M., 2019. P. 1204.

[5] Hereinafter, the data presented in the statistical collections "Regions of Russia. Socio-economic indicators" for 2015–2019 and on the official website of Rosstat. URL: https://www.gks.ru.

Table 1

Healthcare Correlation Matrix

	Number of hospital beds	Capacity of outpatient organizations	Number of doctors	Number of nursing staff	Morbidity
Number of hospital beds	1.00				
Capacity of outpatient organizations	0.53	1.00			
Number of doctors	0.44	0.40	1.00		
Number of nursing staff	0.58	0.57	0.49	1.00	
Morbidity	0.28	0.44	0.20	0.39	1.00

Source: developed and compiled by the authors based on Rosstat data. URL: https://www.gks.ru (accessed on 18.02.2020).

The table shows that there is no significant dependence (at least a linear pair dependence) between the considered indicators (the maximum value is 0.58), which allows further use of total selected factors.

To exclude the influence of the factor of indicator dimensions, they are first preset by the formula

$$Y_i^n = \frac{Y_i - Y_{\min}}{Y_{\max} - Y_{\min}} \quad (1)$$

where Y_i — is the value of the indicator for the *i*-th region; $Y_{\min}$, $Y_{\max}$ — are the minimum and maximum values of the indicator for all considered regions, respectively; Y_i^n — is the normalized value of the indicator for the *i*-th region.

The integral indicator of the development of the healthcare system is calculated by the formula

$$Y_{health}^n = \sqrt[4]{Y_{bed}^n * Y_{out}^n * Y_d^n * Y_{ns}^n}, \quad (2)$$

where Y_{health}^n is the value of the integral indicator of provision of healthcare services in the region;

Y_{bed}^n is the normalized value of the indicator "Number of hospital beds per 10,000 people" in the *i*-th region;

Y_{out}^n is the normalized value of the indicator "Capacity of outpatient organizations per 10,000 people" in the *i*-th region;

Y_d^n is the normalized value of the indicator "Number of doctors of all specialties per 10,000 people" in the *i*-th region;

Y_{ns}^n is the normalized value of the indicator "Number of nursing staff per 10,000 people" in the *i*-th region;

Y_{mor}^n is the normalized value of the indicator "Morbidity rate per 1000 people" in the *i*-th region.

The indicator of provision of cultural and leisure services could be calculated in a similar way. After the indicators are normalized, they are convolved by the formula

$$Y^n_{c-l} = \sqrt[5]{Y^n_{th} * Y^n_{sp} * Y^n_{lib} * Y^n_{camp} * Y^n_{vaf}}, \quad (3)$$

where Y^n_{c-l} is the value of the integral indicator of provision of cultural and leisure services in the region;

Y^n_{th} is the normalized value of the indicator "Number of spectators in theaters and number of visits to museums per 1000 people" in the *i*-th region;

Y^n_{sp} is the normalized value of the indicator "Number of gyms and flat sports facilities per 1000 people" in the *i*-th region;

Y^n_{lib} is the normalized value of the indicator "Library stock per 1000 people" in the *i*-th region;

Y^n_{camp} is the normalized value of the indicator "Number of children who went to children's health camps per 1000 people" in the *i*-th region;

Y^n_{vaf} is the normalized value of the indicator "Number of people accommodated in voluntary accommodation facilities per 1000 people" in the *i*-th region.

In this case, we revealed no significant connection between the considered indicators (*Table 2*).

According to the analysis of housing and communal infrastructure (as part of social infrastructure), it should be noted that "improvement of the housing stock" is a very wide concept and includes (according to Rosstat) water supply, sanitation (sewage), heating, bathtubs (shower), gas (mains, liquefied), hot water supply and outdoor electric stoves. At the same time, these parameters cannot be equally applied for various territories (including, due to objective, for example, geographical and natural-climatic features). In particular, these aspects should be considered when analyzing the regions of the Far East (Kamchatka Krai, Magadan region, Chukotka Autonomous region) in terms of the housing stock equipped with gas supply. At the same time, the availability of bathtubs and floor electric stoves is extremely heterogeneous in the regions of Russia. In this regard, within the study, improvement of the housing stock is determined as the average value of such indicators as water supply, sanitation, heating and hot water supply.

On the other hand, the Decree of the President of the Russian Federation "On National Goals ..." implies not only an increase in housing construction to at least 120 million square meters per year, but also a radical increase in the comfort of the urban environment, creation of a mechanism for direct participation of citizens in its formation. At the same time, it is necessary to provide affordable housing for middle-income families.

The correlation analysis did not reveal a significant connection between the considered indicators (*Table 3*).

Accordingly, the integral indicator is calculated by the formula

$$Y^n_{hous} = \sqrt[5]{Y^n_{rp} * Y^n_{em} * Y^n_{impr} * Y^n_{com} * Y^n_{exp}}, \quad (4)$$

where Y^n_{hous} is the value of the integral indicator of housing and communal infrastructure in the region;

Y^n_{rp} is the normalized value of the indicator "Total area of residential premises, in average per inhabitant" in the *i*-th region;

Y^n_{em} is the normalized value of the indicator "Proportion of emergency housing stock in the total area of the entire housing stock" in the *i*-th region;

Y^n_{impr} is the normalized value of the indicator "Proportion of the total area with water supply, sanitation, hot water supply" in the *i*-th region;

Y^n_{com} is the normalized value of the indicator "Commissioning of residential buildings per 1000 people" in the *i*-th region;

Y^n_{exp} is the normalized value of the indicator "Proportion of household expenses on housing and public utilities" in the *i*-th region.

Provision of education services is also an indicator that includes a number of particular parameters characterizing different levels of education [11]. In particular, they include:

Table 2

Correlation matrix of indicators of the cultural and leisure sphere

	Visiting theaters and museums	Gyms and flat sports facilities	Library stock	Number of children who went to children's health camps	Number of people accommodated in voluntary accommodation facilities
Visiting theaters and museums	1.00				
Gyms and flat sports facilities	–0.25	1.00			
Library stock	0.18	0.35	1.00		
Number of children who went to children's health camps	–0.22	0.38	0.29	1.00	
Number of people accommodated in voluntary accommodation facilities	0.47	–0.26	0.05	–0.06	1.00

Source: developed and compiled by the authors based on Rosstat data. URL: https://www.gks.ru (accessed on 18.02.2020).

Table 3

Correlation matrix of indicators of housing and communal infrastructure

	Housing	Substandard housing	Housing improvement	Housing commissioning	Expenses on housing and public utilities
Housing	1.00				
Substandard housing	–0.16	1.00			
Housing improvement	0.09	–0.11	1.00		
Housing commissioning	0.28	-0.06	0.08	1.00	
Expenses on housing and public utilities	0.42	0.26	0.20	–0.07	1.00

Source: developed and compiled by the authors based on Rosstat data. URL: https://www.gks.ru (accessed on 18.02.2020).

5. Provision of preschool children with places in organizations engaged in educational activities for educational programs of preschool education and childcare; places per 1000 children.

6. Number of teachers in organizations engaged in educational activities on educational programs of primary, basic and secondary general education per 1000 students.

7. Number of students in afternoon and night shifts in organizations engaged in educational activities for educational programs of primary, basic and secondary education.

8. Number of students enrolled in undergraduate, specialty, graduate programs per 10,000 people.

When developing a national project in education, the Decree of the President of the Russian Federation sets objectives, including: to introduce new methods of training and education at the levels of basic and secondary general education, to create conditions for the early development of children under three years old, and to introduce a national system of professional growth for teachers, to update vocational education, and to develop a system of continuous updating of their professional knowledge by working citizens. That is, it is not a question of a particular educational level, but of the entire educational system, covering preschool education, secondary, higher, etc.

The correlation analysis (*Table 4*) showed that the dependence between these indicators is also insignificant.

At the same time, a bigger number of students in afternoon and night shifts is considered as a negative phenomenon.

The integral indicator is calculated by the formula

$$Y_{ed}^{n} = \sqrt[4]{Y_{pre}^{n} * Y_{teach}^{n} * Y_{shift}^{n} * Y_{stud}^{n}}, \quad (5)$$

where Y_{ed}^{n} is the value of the integral indicator of educational services in the region;

Y_{pre}^{n} is the normalized value of the indicator "Provision of preschool children with places in organizations engaged in educational activities for educational programs of preschool education and childcare; places per 1000 children" in the *i*-th region;

Y_{teach}^{n} is the normalized value of the indicator "Number of teachers in organizations engaged in educational activities on educational programs of primary, basic and secondary general education per 1000 students" in the *i*-th region;

Y_{shift}^{n} is the normalized value of the indicator "Number of students in afternoon and night shifts in organizations engaged in educational activities for educational programs of primary, basic and secondary education" in the *i*-th region;

Y_{stud}^{n} is the normalized value of the indicator "Number of students enrolled in undergraduate, specialty, graduate programs per 10,000 people" in the *i*-th region.

An assessment of the development of the region's social infrastructure in the sphere of trade and services implies a study of indicators characterizing retail trade, public catering turnover, volumes of paid services to the population, including household, transport and communication services. These indicators also make it possible to assess the income level of the population. Considering the high share of the shadow economy in a number of regions of the Russian Federation [12, 13], the indicators of the expenses of the population are often more adequate in reflecting the standard of living, than average monthly wages of employees of enterprises and organizations or average per capita monetary incomes of the population. Besides, one may use indicators characterizing this sphere not from a financial point of view, but in physical terms, including density of various types of roads, volume of transportation of people and goods, number of buses, number of connected devices of various types of communication, etc. However, the analysis helped establish the redundancy of this set of parameters. In partic-

Table 4

Correlation matrix of education indicators

	Provision of places for pre-school education	Provision of teachers	Students in afternoon shift and night shift	Students
Provision of places for pre-school education	1.00			
Provision of teachers	–0.09	1.00		
Students in afternoon shift and night shift	–0.50	–0.02	1.00	
Students	–0.26	–0.05	–0.15	1.00

Source: developed and compiled by the authors based on Rosstat data. URL: https://www.gks.ru (accessed on 18.02.2020).

Table 5

Correlation matrix of trade and services indicators

	Retail	Catering	Paid services	Domestic services	Transport services	Communication services
Retail	1.00					
Catering	0.63	1.00				
Paid services	0.77	0.59	1.00			
Domestic services	0.37	0.24	0.49	1.00		
Transport services	0.67	0.54	0.90	0.24	1.00	
Communication services	0.63	0.51	0.81	0.08	0.79	1.00

Source: developed and compiled by the authors based on Rosstat data. URL: https://www.gks.ru (accessed on 18.02.2020).

ular, *Table 5* presents a part of the correlation matrix that shows a close correlation between the volume of paid services to the population and the volumes of transport and communication services. In this regard, it seems appropriate to exclude the indicator "Volume of paid services to the population" from further consideration.

With this in mind, we suggest calculating the integral indicator by the following formula

$$Y^n_{trade} = \sqrt[5]{Y^n_{retail} * Y^n_{cat} * Y^n_{dom} * Y^n_{trans} * Y^n_{comm}}, \quad (6)$$

where Y^n_{trade} is the value of the integral indicator of trade and services in the region;

Y^n_{retail} is the normalized value of the indicator "Retail trade turnover" in the *i*-th region;

Y^n_{cat} is the normalized value of the indicator "Public catering turnover" in the *i*-th region;

Y^n_{dom} is the normalized value of the indicator "Volumes of domestic services per person" in the *i*-th region;

Y^n_{trans} is the normalized value of the indicator "Volumes of transport services per person" in the *i*-th region;

Y^n_{comm} is the normalized value of the indicator "Volumes of communication services per person" in the *i*-th region.

The development of each of these spheres is impossible without adequate financial support. In modern conditions, we refer not only to public funding, but also about private investment. Moreover, the role of the state in this case should be primarily in providing the conditions for expanding the possibilities to finance social infrastructure by enterprises and organizations, since its development is not actually the goal of the implemented measures, but serves to achieve a goal of a higher national character — to solve the demographic problem. Thus, the adoption of measures to financially stimulate a particular area should be evaluated from this position. For this, scientifically based approaches should be developed, including those based on the methods of economic and mathematical modeling.

APPROACH TO MODELING AND ASSESSING THE IMPACT OF DEVELOPMENT OF THE REGION'S SOCIAL INFRASTRUCTURE ON DEMOGRAPHIC PROCESSES

Considering the impact of the development of social infrastructure and the financing of these areas on the demographic parameters of the Russian regions, it is necessary to study the complex impact of various parameters. In this regard, it is necessary to convolve indicators of the development of social infrastructure in certain areas of social life into a general indicator of the development of social infrastructure. However, one should consider the fact that one or another aspect of the development of social infrastructure can have a different impact on the elements of the demographic situation. Thus, an analysis of the literature suggests that healthcare development indicators influence more on changes in the birth rate in the region, rather than the cultural ones [14]. At the same time, the provision of housing and the possibility to obtain a quality education will become a significant factor for migration.

In this regard, a general integral indicator of the development of social infrastructure would not allow considering differences in the degree of influence of each component on the demographic situation. In our opinion, it is better to formulate three integral indicators based on a general list of components of social infrastructure, however, with different weight characteristics, depending on the degree of their influence on birth rate, mortality and migration. In this case, the most difficult and controversial issue is to determine weight characteristics for each of the elements in the equation. The expert method is most commonly used in this case. However, regarding the problem under consideration, the expert approach is applicable to a very limited extent and requires involving a large number of various specialists. We assumed that improvements in any sphere of the development of social infrastructure should not be considered as a reason for worsening the situation in any element of the demographic development of the territory, i.e. weight characteristics must have a value equal to or greater than zero.

Having examined various methods and criteria for determining weight coefficients, we proposed the following algorithm for their determination.

At the first stage, a correlation analysis is carried out to determine the relationship between the parameter of the demographic situation and the development levels of social infrastructure in each of the spheres under

Table 6

Correlation analysis results and normalized values of correlation coefficients (in brackets)

	Birth rate	Mortality	Migration
Healthcare	0.02 (0.89)	0.02 (0.64)	–0.40 (0.00)
Education	–0.43 (0.00)	–0.38 (0.10)	0.12 (0.54)
Culture	–0.24 (0.38)	–0.46 (0.00)	–0.02 (0.40)
Housing	–0.38 (0.10)	–0.24 (0.29)	0.56 (1.00)
Trade and services	0.07 (1.00)	0.28 (1.00)	0.10 (0.52)

Source: developed and compiled by the authors based on Rosstat data. URL: https://www.gks.ru (accessed on 18.02.2020).

consideration. These correlation coefficients will be further interpreted as the basis for determining the weight characteristics. For this, they are normalized. Normalized values of indicators act as weight characteristics. Thus, all weights have values from 0 to 1. As noted above, all indicators were also pre-normalized to exclude the influence of different sizes of indicators. At the same time, we considered indicators for 85 constituent entities of the Russian Federation that allowed the formation of relevant data series.

Table 6 presents the results of the correlation analysis.

The significance of the calculated linear correlation coefficients (at $\alpha = 0.05$), determined by the Student's criterion, in most cases exceeds the threshold value. Pairs "Culture" — "Migration" and "Culture" — "Birth rate" are the exceptions. However, to keep the logic of the research, these factors were not excluded from further consideration.

The results can be interpreted as follows.

The development of healthcare has a positive effect on the parameters of birth rate and mortality, since the volume and quality of the medical services are fundamental for a healthy and active life. However, the key factors of migration are completely different parameters. Job search [15], getting a higher education [16], and returning to one's previous place of residence are the most often reasons for migration. In this case, the factors of developing the push-pull migration are not considered [17]. In this regard, the impact of the healthcare development on migration is much lower than the impact of the development of social infrastructure in education. On the other hand, the mortality rate is much higher among people of the older age. The development of the education system cannot have a significant impact on this indicator.

Cultural and leisure services are not regarded as priority for any of the elements of the demographic system of the region. These needs are secondary, and people are mostly ready to re-

fuse some of them in favor of other factors. Besides, some of them can exist without developed social infrastructure in this sphere. For example, theaters and museums can be replaced by cinemas, TV shows or relevant content in the Internet, and attending cultural events is possible within tourist trips to more developed regions and cities [18]. The lack of public libraries is compensated by the possibility to buy (receive) books, both paper and electronic, as well as to replace reading with watching movies or getting information in a different way. Popular workout trainings, as well as other types of sports that do not require special facilities, partially compensates for the lack of sports facilities.

According to the study, the value of the integral indicator of housing and communal infrastructure is primarily significant for the migration component of the demographic situation, which is also determined by the role of housing as an indicator of the quality of life of the population. At the same time, a low level of housing is typical for many regions with a high birth rate. In the republics of Chechnya, Dagestan, Ingushetia, Tyva, leading in the total birth rate, housing per capita is only 55–72% of Russia's average value.

The trade development shows, on the one hand, the availability of infrastructure for retail trade, and on the other hand, the financial ability of the population to purchase goods and pay for services. Thus, the indicator to a certain extent characterizes the standard of living of the region's population in general, and not just in relation to trading activities. In this aspect, a significant correlation with improvements in terms of mortality, migration and birth rate becomes obvious. Moreover, this approach allows us to include in the financial model of the social infrastructure formation not only public funds and investments of private companies, but also the financial resources of the population.

The obtained normalized values of indicators regarding the impact of the elements of social infrastructure on the parameters of the demographic situation were the basis for calculating the integral indicators of the development of social infrastructure for the selected areas by formulas (7) — (9).

$$Y^n_{SI\_birth} = 0.89 * Y^n_{health} + 0.38 * Y^n_{c-l} + 0.10 * Y^n_{hous} + 1.00 * Y^n_{trade}, \quad (7)$$

$$Y^n_{SI\_mort} = 0.64 * Y^n_{health} + 0.10 * Y^n_{ed} + 0.29 * Y^n_{hous} + 1.00 * Y^n_{trade}, \quad (8)$$

$$Y^n_{SI\_migr} = 0.54 * Y^n_{ed} + 0.40 * Y^n_{c-l} + 1.00 * Y^n_{hous} + 0.52 * Y^n_{trade}. \quad (9)$$

The resulting set of models ultimately links private indicators of the development of social infrastructure and parameters of the demographic movement of the population in the regions of Russia. Separately from the general economic-mathematical model of the region's development, these equations have significantly less practical significance than if they were considered as a structural element of such a model. We find it sensible to integrate the results into a comprehensive regional development model [19], which includes the parameters of economic, monetary and other activities of the state.

ASSESSMENT OF DEVELOPMENT OF SOCIAL INFRASTRUCTURE IN THE REGIONS OF THE RUSSIAN FEDERATION

The developed set of equations was tested on the reported statistical data on the socio-economic development of the constituent entities of the Russian Federation. *Table 7* presents the calculation results.

The analysis of the results of ranking the regions by the integral indicators of the development of social infrastructure showed a very high differentiation. By the development of social infrastructure in terms of its effect on birth rate, the difference was 5.03 times (the minimum value in the Nenets Autonomous region is 0.3, the maximum is in Moscow 1.51). From the point of view of the impact of social infrastructure on mortality,

Table 7

Integral indicators of social infrastructure development for selected areas

A constituent entity of the Russian Federation	An integral indicator of social infrastructure development			A constituent entity of the Russian Federation	An integral indicator of social infrastructure development		
	$Y^n_{SI\_birth}$	$Y^n_{SI\_mort}$	$Y^n_{SI\_migr}$		$Y^n_{SI\_birth}$	$Y^n_{SI\_mort}$	$Y^n_{SI\_migr}$
Moscow region	0.83	0.85	1.23	Bryansk region	0.87	0.86	1.21
Kaliningrad region	0.93	0.90	1.38	Voronezh region	1.24	1.19	1.42
Leningrad region	0.68	0.69	1.12	Kaluga region	0.89	0.84	1.24
Krasnodar region	1.17	1.07	1.32	Kursk region	1.06	1.05	1.33
Sevastopol	0.99	0.88	1.24	Lipetsk region	1.13	1.09	1.35
Komi Republic	0.82	0.76	0.96	Oryol region	0.86	0.84	1.20
Republic of Kalmykia	0.70	0.66	0.93	Ryazan region	0.90	0.85	1.15
Astrakhan region	0.98	0.93	1.14	Tambov region	1.06	0.99	1.35
Kabardino-Balkarian Republic	0.75	0.74	1.04	Tula region	0.81	0.81	1.14
Karachay-Cherkess Republic	0.61	0.60	0.88	Republic of Adygea	0.80	0.80	1.16
Republic of North Ossetia — Alania	1.01	1.00	1.18	Republic of Mordovia	0.84	0.80	1.14
Stavropol region	0.92	0.90	1.11	Nizhny Novgorod region	0.98	0.95	1.21
Republic of Bashkortostan	1.03	1.01	1.32	Penza region	0.85	0.83	1.23
Mari El Republic	0.70	0.67	1.09	Samara region	0.83	0.84	1.14
Udmurt republic	0.84	0.82	1.09	Saratov region	0.87	0.86	1.08
Chuvash Republic	0.89	0.82	1.14	Ulyanovsk region	0.77	0.77	1.13
Perm region	0.83	0.81	1.02	Novosibirsk region	0.88	0.88	1.20
Orenburg region	0.92	0.88	1.12	Vladimir region	0.85	0.79	1.15
Chelyabinsk region	0.81	0.79	1.08	Ivanovo region	0.74	0.72	1.01
Republic of Khakassia	0.81	0.78	1.08	Kostroma region	0.79	0.76	1.12
Zabaykalsky Krai	0.84	0.76	0.88	Smolensk region	0.90	0.81	1.05
Krasnoyarsk region	0.91	0.85	1.05	Tver region	0.78	0.72	1.06
Irkutsk region	0.77	0.74	1.03	Yaroslavl region	0.94	0.85	1.19

Continuation of Table 7

A constituent entity of the Russian Federation	An integral indicator of social infrastructure development			A constituent entity of the Russian Federation	An integral indicator of social infrastructure development		
	$Y^n_{SI\_birth}$	$Y^n_{SI\_mort}$	$Y^n_{SI\_migr}$		$Y^n_{SI\_birth}$	$Y^n_{SI\_mort}$	$Y^n_{SI\_migr}$
Omsk region	0.92	0.85	1.07	Republic of Karelia	0.78	0.70	1.05
Tomsk region	0.83	0.82	1.10	Arkhangelsk region	0.96	0.88	1.00
Moscow	1.51	1.38	1.51	Vologda region	0.70	0.68	0.98
Saint Petersburg	1.46	1.28	1.58	Novgorod region	0.97	0.85	1.16
Republic of Tatarstan	1.14	1.09	1.45	Pskov region	0.76	0.70	1.10
Sverdlovsk region	1.11	1.08	1.25	Republic of Crimea	0.80	0.68	0.96
Tyumen region	0.94	0.88	1.07	Volgograd region	0.95	0.90	1.11
Khanty-Mansiysk Autonomous region — Ugra	0.87	0.84	1.01	Rostov region	0.89	0.87	1.13
Kamchatka Krai	0.86	0.80	1.09	Kirov region	0.83	0.79	1.04
Khabarovsk region	1.24	1.14	1.18	Kurgan region	0.56	0.55	0.99
Sakhalin region	1.18	1.11	1.18	Altai region	0.75	0.72	1.03
Murmansk region	0.89	0.85	0.98	Kemerovo region	0.82	0.77	1.04
Yamal-Nenets Autonomous region	0.79	0.75	0.81	Primorsky Krai	0.95	0.86	1.00
Altai Republic	0.74	0.61	0.90	Amur region	0.97	0.82	0.86
Republic of Buryatia	0.93	0.82	0.86	Jewish Autonomous region	0.70	0.62	0.81
Tyva Republic	0.72	0.60	0.67	Nenets Autonomous region	0.30	0.34	0.92
Republic of Sakha (Yakutia)	0.87	0.78	0.80	Republic of Dagestan	0.50	0.63	1.03
Magadan region	1.17	1.03	1.10	Republic of Ingushetia	0.45	0.52	0.83
Chukotka Autonomous region	0.80	0.74	0.92	Chechen Republic	0.32	0.46	0.97
Belgorod region	1.06	1.04	1.44				

Source: developed and compiled by the authors.

the same regions are the leaders and outsiders. Here, Moscow (1.38) is 4.06 times ahead of the Nenets Autonomous region (0.34). From the point of view of migration processes, the presented approach made it possible to obtain differences between the maximum value in St. Petersburg (1.58) and the minimum one in the Republic of Tyva (0.67) at the level of 2.36 times. In most cases, there is a connection with the differentiation of Russian regions by economic parameters, which is consistent with studies by other authors [20]. One should discuss the complex influence of heterogeneous factors and the mutual strengthening of differentiation processes.

CONCLUSIONS

The study results are the ratings of the constituent entities of the Russian Federation by the development of social infrastructure. They suggest that the social infrastructure of the region can have different effects on individual components of its demographic development. In this regard, creating favorable conditions for migration growth in the region does not guarantee an increase in the birth rate or a decrease in the mortality rate, and vice versa. Forecasting the population of a particular territory requires a deep analysis of all the components and factors of demographic processes. Therefore, developing public policy measures in the field of demographic development and, consequently, an appropriate financial base, should consider how much the development of a particular component of the region's social infrastructure affects each component of its demographic development. The results may be of further use to state authorities at the federal and regional levels in solving the corresponding problems.

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Fattakhov R. V. — introduction; relevance of the research topic and problem statement; development of the research methodology; interpretation of the results.
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Oreshnikov V. V. — statistical data analysis; description of the calculation method; analysis of the results; tabular and graphical presentation of the results.

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