REGIONAL ECONOMICS

Modern Development of the System of Cities in Russia: Static and Dynamic Approaches

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Abstract. The article raises the issues of urban transformation. The provisions of the new economic geography state that large cities get agglomeration effects from overcrowding, businesses and amenities. But practice shows that medium and small cities often have more prospects for development. Borrowed size (the location of a small or medium-sized city or settlement near a larger one) allows residents to use some of the services of neighboring cities without incurring the associated costs. The possibility of borrowing agglomeration advantages is forming a new system of cities. The distribution of population and economic activity does not always occur around administrative centers, there is a polycentricity of spatial development. To analyze the system of cities we proposed to use static and dynamic approaches that allow us to determine more fully the reasons for the attractiveness of cities and population growth. We constructed a system of econometric models of the influence of high order urban functions — factors of economy, education, culture and sports — on the number of residents of cities in the Central Federal

District of Russia as a whole and by size categories. The analysis of polycentricity of cities revealed that a high level of the indicator is observed in the Moscow, Vladimir, Belgorod, Tula, Tver and Kaluga oblasts, and low polycentricity is in the Lipetsk, Ryazan, Voronezh and Orel oblasts. It was determined that the attractiveness of cities and the growth of their population are influenced by high-order urban functions (business, science, sports and culture), the ability to take advantage of "borrowed" size, the external effects of the urban network and the level of inter-city cooperation. The most significant factor in the growth of the city is the number of schools. The second factor is the possibility for children and adolescents to join sports clubs. Budget expenditures have a positive impact on the growth of large, big and small cities. Cultural and recreational activities are significant for the attractiveness of cities with a population of up to 10 thousand people and from 15 to 20 thousand people. It was revealed that more than a half of settlements in the Central Federal District are cities and urban-type settlements with population less than 10 thousand people. For this group, all the considered development factors are statistically significant and important. The results can be used to further develop the ideas of static and dynamic analysis to assess the reasons for the attractiveness of cities, substantiate the "borrowed size factor", and determine general trends in the system of cities formation. The practical value of the work lies in a better understanding of the principles for creating an attractive city for residents at different stages and conditions of its development; it can be used in the development of appropriate socio-economic programs at the city and regional levels.

Key words: borrowed city size, high-order urban functions, polycentricity of the city system, agglomeration effects, cities and regions of Russia.

Introduction

The polycentricity of the urban system in Russia explains the multidirectional trends of its development. In general, the level of urbanization in the country is approaching its maximum threshold value: in 2022 it reached 74.8%, increasing annually since 2016 by 0.12 p.p. At the same time, in a number of regions the share of urban population over the same period decreased: by 1 p.p. in the Irkutsk Oblast, by 0.5 p.p. in the Moscow Oblast, Jewish Autonomous Oblast and the Samara Oblast, by 0.4 p.p. in the Murmansk and Yaroslavl oblasts and Adygea Republic, by 0.2 p.p. in the Astrakhan and Kaluga oblasts, by 0.1 p.p. in the Tula and Moscow oblasts and Altai Republic[1].

The growth of large cities and the level of urbanization corresponds to the provisions of research emphasizing the importance of agglomeration (Glaeser, 2011) and is theoretically justified by the provisions of the new economic geography (Fujita et al., 1999). At the same time, the decrease in urbanization is confirmed by individual trends, for example, in Western Europe (Meijers et al., 2016). A number of countries are currently experiencing the growth of medium-sized and small cities, rather than large ones[2] (Rastortseva, Manaeva, 2022a; Camagni et al., 2017). Polycentricity is increasing — cities form socio-economic clusters, often without adhering to administrative or historical boundaries of cooperation.

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[1] Calculation based on: Showcase of statistical data. Federal State Statistics Service of the RF. Available at: https://showdata.gks.ru/report/278932/ (accessed: September 15, 2022).

[2] Criteria for categorizing Russian cities as millionaires, largest, large, big, medium-sized, and small are presented in (Rastvortseva, Manaeva, 2022a). In addition, the definition of a large city in Russia and other countries differs.

It is believed that the key factors in urban growth are economic (or business, attracting business structures), scientific and educational, cultural, leisure and other factors. Considering the full range of conditions, we understand that these factors vary depending on the size of the city.

The purpose of the study is to identify the main trends in the development of the city system through the assessment of polycentricity and the use of static and dynamic approaches to identify the impact on urban development of such factors as education, economy, culture and sports.

The first section of the article presents a theoretical and bibliographic review of studies reflecting the advantages of large cities. The methodological aspects of assessing the development of the city system, namely the definition of polycentricity and specifics of using static and dynamic approaches, and the initial data for the analysis, are considered in the second section. The results of the study are shown in the third section, the conclusion formulates results and directions for further research.

Theoretical and bibliographic review

How can we explain the fact that for all the advantages of large cities from the position of economic rationality, in practice small and medium-sized cities have higher growth rates? Let us determine the reasons for the attractiveness of large cities.

The concentration of social and economic activity in the city, according to the new economic geography, brings rather positive effects for the activity of companies (Krugman, 1991). This means that there are sources of benefits from the location of the company in a large city compared to a medium-sized or small. First, there are the conveniences and higher quality of life (Blomqvist et al., 1988; Carlino, Saiz, 2008). Second, there are the best characteristics of the industrial environment (Chinitz, 1961). By combining different types of economic activities on its territory, the urban environment contributes to better specialization

and diversification, the formation of "connected diversity" (Boschma, Iammarino, 2009). Complementarity between different sectors of the economy guarantees the exchange of knowledge and the diffusion of technology. The interaction of companies goes beyond clusters and extends to the whole urban environment, increasing its efficiency (Rastvortseva, Manaeva, 2022b).

Third, the city creates favorable conditions for social communication and acts as a mediator (Martin et al., 2011). The city becomes a "melting pot of knowledge, culture, and attitudes" (Krugman, 1991, p. 53). Large cities achieve the best results in the field of recruitment. The availability of a highly skilled workforce in various sectors of the economy stimulates higher labor productivity (Shkiotov, Markin, 2020), and therefore makes cities more attractive to new companies (Rastortseva, Manaeva, 2022b).

In the literature, discussions of the benefits of large cities focus on three main aspects: indivisibility, synergy, and physical proximity (Capello, 2009).

Indivisibility is conditioned by a number of conditions arising in agglomeration processes. This is the possibility of sharing the existing and developing infrastructure. We can include here the general labor market, which is formed for the specific needs of industries operating in the city, intermediaries and service firms. Indivisibility arises when companies strive to standardize production processes and achieve the benefits of scale effect (internal and external). The city and the urban economy benefit from indivisibility: increased attractiveness for large companies, the formation of institutions and infrastructure for the development of self-sustaining agglomeration process, reduced unemployment with a high probability of more effective recruitment and attraction of a large number of specialists, the formation of creative capital. Indivisibility occurs when the benefits of agglomeration effects (externalities) increase overall factor productivity (Rosenthal, Strange, 2001).

A number of studies have assessed how much more companies benefit from agglomeration when they operate only in their industry with other companies or when they are in a set of interrelated industries (Carlino, 1980; Henderson, 1985).

The synergy aspect is more related to the socio-cultural changes that arise in agglomeration processes. Here we can refer changes in the level of trust, the sense of belonging, the increase of cultural homogeneity, the intensity of local interactions, which eventually leads to an increase in returns by minimizing transaction costs (Becattini, 1989). It is under these conditions, representatives of different (even competing) companies have the opportunity to conduct interpersonal contacts, which contributes to a better dissemination of information, including in an implicit form. Synergy leads to the formation and development of creative capital, which, in turn, attracts new professionals to the city or region, allows them to create more comfortable and attractive living conditions for themselves, which ultimately supports agglomeration processes. The development of synergy as an important component of agglomeration processes in the city often takes place in the framework of programs to promote innovation with public support (Camagni, 1991; Storper, 1995).

The third aspect of the advantage of large cities is proximity. If the economy lacks the costs of transporting goods, raw materials, and other resources, and there are no barriers to the transfer of information, then the idea of concentrating economic activity in one area loses its meaning. Proximity is related to geographic agglomeration and interaction effects.

The highlighted three aspects can be explained in terms of three approaches to the sources of agglomeration economies. The indivisibility of the labor market, production processes is determined by technical effect of scale. Indivisibility reduces costs and increases total factor productivity at the firm level (microindustrial approach). Synergy reduces transaction costs and, together with proximity (geographic approach), represents the macro-territorial level (Camagni et al., 2017). The sources of static agglomeration savings and dynamic efficiency in all approaches have their own specifics.

The reasons why larger cities are attractive to companies should be taken into account when analyzing the static picture (current advantages of a city) and the dynamic situation (changes in advantages and potential as the city's population grows).

Methodological approaches to the urban development assessment: Polycentricity, static and dynamic approaches

The system of cities can be evaluated through the polycentricity index. A polycentric region is a set of cities that are often historically and administratively different, but territorially close and connected to each other. Understanding the degree of urban system polycentricity in a region allows us to determine how likely settlements can benefit from agglomeration processes. The polycentricity index can be measured by the Herfindahl − Hirschman index (H).

$$H = \sum_{i=1}^{N} S_i^2, \qquad (1)$$

where S_i is the share of the population of city i in the total population of all cities in the region,

N is the number of cities in the region.

The value of the polycentricity index can range from $1/N$ to 1. The lower the index, the more polycentric the system of cities in the region[3].

The main methods for analyzing the cities system development are static and dynamic approaches, which provide information about the main trends and reasons for development.

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[3] The use of the Herfindahl − Hirschman index in analyzing polycentricity can be noted in (Meijers et al., 2018; Meichang, Bingbing, 2020; Hoogerbrugge et al., 2022), in analyzing economic spatial structure in (Liu et al., 2022).

The advantages of large cities over small ones are identified through a comparative analysis of the system of cities in a particular period of time. This approach is called a static approach. It shows which size cities have a higher level of attractiveness and whether it decreases or increases as the population changes. Constructing econometric models reveals a set of development factors for cities of a certain size, but does not actually show whether a city's population will grow or decline under certain conditions.

Dynamic analysis tells us about future development trends. It is conducted over a period of time and does not just show the significant factors, but also reflects their impact on possible trends in the dynamics. Such factors should include the internal characteristics of the city. For example, there is the opinion that agglomeration processes alone do not stimulate urban growth and efficiency, just as urbanization itself in terms of the number of inhabitants does not guarantee accelerated economic development (Henderson, 2010). Static and dynamic approaches are characterized by a different set of research questions (Camagni et al., 2017).

Citywide attractiveness can be evaluated by different indicators. For example, urban land rents, taking into account the net benefits of location (benefits minus costs) (Albouy, 2009). The use of this indicator is logically explained by the fact that in large cities real estate is more expensive. In our view, the indicator has three disadvantages. For example, due to the artificial limitation of the supply of new housing construction, it is in large cities that price shifts are possible (Cheshire, Sheppard, 2002). Further, large cities are much more often administrative centers, the concentration of management functions requires the presence of a significant number of staff and thus increases housing prices. Finally, for an actual analysis, we need data on real estate values not only in large cities, but also in medium-sized and small towns.

Their absence or difficulty in obtaining them may distort the results obtained.

The easiest and most accessible indicator of a city's attractiveness is the size of its population. ***The size of the city by the number of inhabitants***, in our view, can be both a factor and a resultant indicator. The new economic geography considers a circular causality relationship that explains the self-sustaining nature of agglomeration processes. Cities with a higher number of population may be more attractive to new residents, while population size can act as a key indicator of a city's prosperity (Rastvortseva, 2013).

In some states, population mobility is higher and changes in population are faster. But even in countries where the population is low-mobile, such as Russia, changes occur as a result of natural or mechanical movement. We believe that for the static analysis — the number, and for the dynamic — its change in the dynamics — are the most appropriate indicators.

Factor indicators of city attractiveness can be high-level urban functions, "borrowed size" and externalities of the urban network, or the degree of urban cooperation (Camagni et al., 2017).

High-level city functions (for example, the share of administrative employees in the total number of employees). It is believed that the presence of such functions will contribute to the qualitative shift of the city's efficiency curve. Such a positive effect persists at any size of the city. High-level functions may include business, science, sports, and culture (Meijers et al., 2016).

"Borrowed size" is the extent to which a small or medium-sized city uses the advantages of a larger city nearby. The effects of "borrowed size" are defined through population, statistically and dynamically, and through city functions at different levels. We can assume that a large city receives such advantages as an influx of commuting migrants (this increases the labor market), reduced tension in the real estate market (due to the fact that workers live

Table 1. Indicators for empirical analysis

Variable	Designation	Explanation	Period and data source
Population size	*ln_Y*	Population of the city	2021; The resident population of the Russian Federation by municipalities by January 1, 2021. Available at: https://rosstat.gov.ru/storage/mediabank/ (accessed: September 16, 2022).
Education	*ln_school_learn*	The number of students in general education organizations, including separate subdivisions, people	2017; Economy of Russian municipalities, Multistat – Multifunctional statistical portal
	ln_schools	Number of general educational organizations at the beginning of the school year, units	2017; Economy of Russian municipalities, Multistat – Multifunctional statistical portal
Economy	*ln_budg_exp*	Local budget expenditures actually executed, thousand rubles	2018; Economy of Russian municipalities, Multistat – Multifunctional statistical portal
Culture	*ln_culture*	The number of people working in cultural and leisure organizations, including separate subdivisions, total, persons	2017; Economy of Russian municipalities, Multistat – Multifunctional statistical portal
Sport	*ln_sport*	The number of students in children's and youth sports schools, people	2017, 2018; Economy of Russian municipalities, Multistat – Multifunctional statistical portal

outside the city), and increased opportunities for interpersonal communication. The disadvantages of this connection are traffic congestion, pollution, and high travel costs for workers.

Small and medium-sized cities benefit from the fact that they can develop some services not within themselves, but use them in larger cities. Among the "borrowed functions" are theaters, concert venues, museums, universities, ports and airports, sports arenas, parks and zoos, large hospitals, and other organizations of education, science, culture, sports, leisure, health, logistics, etc.

For the empirical part of the study, we defined the cities and towns of the Central Federal District (CFD) of Russia as the object. Detailed indicators and sources of information are presented in *Table 1.*

Earlier (Rastvortseva, Manaeva, 2022) we provided a rationale for the influence of educational, economic, cultural, and sports factors on the development of cities of different sizes. In the works of Russian researchers, we can note this set of factors in different interpretations. Thus, O.O. Smirnov and V.A. Bezverbnyi refer to the educational system the development of the academic environment of the city (Smirnov, Bezverbnyi, 2022), A.A. Buvin and V.I. Khabarov in the healthcare system of cities

emphasize digitalization trends (Buvin, Khabarov, 2022), E.A. Kolomak (Kolomak, 2022) highlights the housing stock, the number of doctors, market cities, etc.

Results of the study

Let us determine how polycentric is the urban structure of the CFD according to the Herfindahl – Hirschman index, the number of cities and towns, and the number of urban residents (*Tab. 2*).

We would like to point out that the number of cities and towns in the regions of the Central Federal District has not changed during the period under analysis. The number of city residents in the district decreased by 84,623 people over the year. The largest decrease occurred in the Vladimir (14,544), Tula (14,211), Yaroslavl (12,626) and Tver (11,126) oblasts. An increase in the number of residents occurred in the Moscow (37,665) and Kaluga (9,910) oblasts.

The dynamics of the polycentricity index is quite difficult to trace over the year – the concentration of population in cities changes slowly. But we can see some trends – a decrease in the Orel (-0.0021 units) and Tula (-0.000 units) oblasts, the largest increase in the Kostroma and Tver (0.0044 units each), Voronezh (0.0034 units) and Ryazan (0.002 units) oblasts.

Table 2. Urban polycentricity of the Central Federal District regions in 2021

Region	Number of cities	Number of urban-type settlements	The number of urban residents*		Polycentricity**	
			on January 1, 2021	on January 1, 2022	on January 1, 2021	on January 1, 2022
Belgorod Oblast	11	18	1 041 310	1 037 398	0.201	0.202
Bryansk Oblast	16	23	833 197	825 055	0.2441	0.2449
Vladimir Oblast	23	9	1 049 234	1 034 690	0.1506	0.1513
Voronezh Oblast	15	17	1 567 046	1 558 117	0.4562	0.4596
Ivanovo Oblast	17	13	807 364	799 962	0.2705	0.2729
Kaluga Oblast	22	7	758 763	768 673	0.2247	0.2254
Kostroma Oblast	12	7	459 063	455 546	0.378	0.3824
Kursk Oblast	10	22	752 748	745 355	0.3818	0.3832
Lipetsk Oblast	8	0	729 043	718 936	0.5023	0.5024
Moscow Oblast	74	73	6 296 406	6 334 071	0.0235	0.0237
Orel Oblast	7	13	483 481	476 031	0.4125	0.4104
Ryazan Oblast	12	21	793 275	783 514	0.4608	0.4628
Smolensk Oblast	15	10	663 281	656 710	0.2576	0.2578
Tambov Oblast	8	12	611 901	605 394	0.2603	0.2614
Tver Oblast	23	28	950 071	938 945	0.2152	0.2196
Tula Oblast	19	11	1 082 882	1 068 671	0.2144	0.2141
Yaroslavl Oblast	11	11	1 011 966	999 340	0.3912	0.3911

* Residents of cities and urban-type settlements.
** Herfindahl – Hirschman Index.
According to: The resident population of the Russian Federation by municipalities on January 1, 2021, on January 1, 2022. Federal State Statistics Service. Available at: https://rosstat.gov.ru/ (accessed: September 16, 2022; February 1, 2023). Information on the number of cities and urban-type settlements was obtained from the Internet resources for each oblast individually.

We remind that the lower the Herfindahl – Hirschman index, the higher the polycentricity of a region. The highest polycentricity is observed in the Moscow Oblast, which is the leader both by the number of inhabitants and by the number of cities and urban-type settlements. The second oblast with a high polycentricity of cities is the Vladimir Oblast. Next are the Belgorod, Tula, Tver, and Kaluga oblasts. The Lipetsk, Ryazan, Voronezh, and Orel oblasts have a low level of polycentricity.

We see that in the Central Federal District on January 1, 2021 there were 303 cities and 295 urban-type settlements with a population of almost 19 million people (excluding Moscow). The largest numbers of urban residents are in the Moscow, Voronezh, Tula, Vladimir, Belgorod, and Yaroslavl oblasts; the smallest numbers are in the Kostroma and Orel oblasts.

The total sample was 598 cities and towns. We note that for some of them there are no individual statistical data, which means that the sample size will vary.

The largest city in the sample is Voronezh, with a population of over 1 million people, the smallest – urban-type settlement Gorodok in Kaluga region with 64 inhabitants. The largest cities (from 500 thousand to 1 million people) include four – Yaroslavl, Ryazan, Balashikha and Lipetsk. Big cities (from 250 thousand) are mostly regional centers, except for two cities in the Moscow Oblast – Podolsk and Khimki. There is a total of 14 large cities in the sample. There are 25 big cities (over 100 thousand inhabitants), mostly located in the Moscow Oblast, except Rybinsk in the Yaroslavl Oblast, Novomoskovsk in the Tula Oblast, Obninsk in the Kaluga Oblast and Zheleznogorsk in the Kursk Oblast.

Medium-sized cities (50,000 to 100,000 people) include 32 cities, and the other 522 are small towns.

A model of the impact of high-level urban functions on population size is:

$$Y = F(Educ, Econ, Cult, Sport), \quad (2)$$

where Y — population of the city or urban-type settlement;

$Educ$ — factors of the education and science system;

$Econ$ — business development and economic factors;

$Cult$ — cultural and leisure factors;

$Sport$ — sport development.

Model 1 (*Tab. 3*) is based on a linear form, models 2 and 3 are based on natural logarithms.

We built three models of the impact of indicators of education, economy, culture, and sports on the cities' population. Model 1 reveals a linear relationship and demonstrates that all of the factors considered have a positive effect on the number of urban residents. We see that the greatest influence is exerted by education. Initially, it was assumed that the model could include the number of students in general education organizations. However, there was a high correlation of this indicator with the total population — the more residents in the city, the more children studying, so this indicator was replaced by the number of general educational institutions. Despite the fact that the occupancy of schools and kindergartens, their number and other parameters are regulated by general norms throughout the country, the correlation with the number of population is not as high. At the same time, this indicator continues to have a greater influence on the city's size.

The second most important factor is the number of students involved in children's and youth sports schools. We should note that there are not many indicators in the available statistics, which could reflect the level of sports development in cities, especially in small ones. The number of schools in a large range of city sizes varies from 1 to 2. At the same time, the number of students in sports schools is different. We can explain it by the availability of coaches, the number of sections, the general organization of sports schools, in other words, the administrative resource. A higher level of sports development for children and young people attracts more residents and plays a role in the choice of the place of settlement.

Table 3. Models of the influence of individual factors on the population of cities and urban-type settlements of the CFD

Indicator	Model 1	Indicator	Model 2	Model 3
Dependent variable	Y	*Dependent variable*	ln_Y	ln_Y
const	-5988*** (1300)	const	4.88*** (0.320)	4.901*** (0,312)
ln_schools	3565.32*** (538,97)	ln_schools	0.56*** (0.061)	0.588*** (0.05)
ln_budg_exp	0.0069*** (0.0026)	ln_budg_exp	0.146*** (0.027)	0.153*** (0.028)
ln_culture	0.059*** (0.019)	ln_culture	0.042 (0.039)	
ln_sport	9.321*** (538.97)	ln_sport	0.322*** (0.044)	0.327*** (0.044)
R^2	0.94	R^2	0.899	0.898
Stand. error	23446	Stand. error	0.423	0.423
Number of observations	423	Number of observations	360	360
const – constant term of equation; *** – significance level 1%; ** – 5%; * – 0%. A standard error is given in parentheses. Source: own compilation.				

There is no direct correlation between the number of city residents and employees of cultural institutions, so the level of cultural development and the availability of attractions in the city are an important but not decisive factor when choosing a place to live. The city's budget expenditures also play an insignificant role, although their growth positively affects the number of residents.

As we noted earlier, the influence of factors in cities of different sizes may vary. We divide cities into groups of large (model 4), big (model 5), medium-sized (model 6), and small (model 7). The results are presented in *Table 4*.

The division of cities into groups according to size shows that the number of schools is always positively reflected in the number of city residents. This factor is more influential in large and small cities, and less influential in medium-sized cities. It is interesting that the culture factor is not statistically significant in large cities. In big cities it has a negative effect on the population. We believe that this can be explained by the outpacing

development of the cultural sector before the immediate growth of the city.

Economic factors are important for urban development and have a positive effect on the population. The only exception is medium-sized cities, where an increase in city budget expenditures does not make the city more attractive.

Sports, namely children's and youth sports, remain an important development factor. To a greater extent it is noticeable in small towns, where an increase in the number of children and youth sport school students by 1% gives an increase in population by 0.327%.

The largest group consists of small towns – 522, of which a full set of data is presented for 360 cities. We propose to consider them in more detail, distinguishing among them groups according to the classification presented in (Rastvortseva, Manaeva, 2022a): with a population up to 10,000 (312 settlements), from 10,000 to 15,000 (77), from 15,000 to 20,000 (38), from 20,000 to 30,000 (51) and from 30,000 to 50,000 (44). The results of the modeling are presented in *Table 5*.

Table 4. Models of the influence of individual factors on the population of large, big, medium-sized and small towns and urban-type settlements of the CFD

Indicator	Model 4	Model 5	Model 6	Model 7
	Large	Big	Medium-sized	Small
const	-5.834*** (1.104)	8.896*** (0.54)	10.656*** (0.139)	4.906*** (0.312)
ln_schools	0.603*** (0.143)	0.488*** (0.107)	0.168*** (0.051)	0.588*** (0.054)
ln_budg_exp	0.249 *** (0.082)	0.07*** (0.017)		0.153*** (0.028)
ln_culture		-0.08** (0.035)		
ln_sport	0.069** (0.03)	0.095* (0.054)		0.327*** (0.044)
R^2	0.864	0.68	0.2	0.898
Stand. error	0.135	0.171	0.177	0.423
Number of observations	19	22	31	360
const – constant term of equation; *** – significance level 1%; ** – 5%; * – 0%. Standard error is given in parentheses. Source: own compilation.				

Table 5. Models of the influence of individual factors on the population
of small towns and urban-type settlements of the CFD

Indicator	Model 8	Model 9	Model 10	Model 11	Model 12
	up to 10,000 people	10,000-15,000 people	15,000–20,000 people	20,000–30,000 people	30,000–50,000 people
const	5.864*** (0.476)	9.321*** (0.032)	9.03*** (0.141)	9.253*** (0.225)	10.511*** (0.369)
ln_schools	0.156*** (0,076)	0.076*** (0.027)	0.043* (0.023)		
ln_budg_exp	0.099 *** (0.032)		0.024* (0.012)		-0.044* (0.024)
ln_culture	0.124** (0.048)		0.044** (0.02)	-0.045*** (0.023)	
ln_sport	0.205*** (0.058)		0.032* (0.015)	0.154*** (0.039)	0.089*** (0.027)
R^2	0.418	0.085	0.338	0.296	0.143
Stand. error	0.357	0.118	0.066	0.103	0.146
Number of observations	144	69	29	38	37

const – constant term of equation; *** – significance level 1%; ** – 5%; * – 0%.
Standard error is given in parentheses.
Source: own compilation.

We see that in the smallest towns (up to 10,000 people) the most important role is played by schools and the opportunity to do sports in children's and youth sports organizations. On the one hand, this can be explained by the fact that in small urban-type settlements there may be no schools or sports sections at all. On the other hand, such settlements lose their attractiveness. A city without a school is like a city without a promising future. At the same time, the impact of cultural facilities and local budget expenditures is positively assessed in such cities. Let us note once again that it is small towns with a population of up to 10,000 people, and there are 312 of them in the CFD, that are the most sensitive to all development factors.

We see a similar situation in the group of cities with a population of 15,000 to 20,000 people. The most important factors are the number of schools, the opportunity for children and adolescents to do sports and the number of employees of cultural and leisure organizations.

In cities with 10 to 15,000 inhabitants, the only statistically significant growth factor is the number of schools. It is noteworthy that this indicator is no longer playing a leading role in the growth of the city (from 20,000 to 50,000 people). It varies considerably in these groups (from 0 to 33). For these groups of cities insignificant or sometimes negative factors are the development of culture and leisure, urban budget expenditures. The sports factor retains a high importance.

Conclusion

Thus, we can see that in regional economic science new factors promoting urban attractiveness are emerging and actively researched, which explain the growth of not only large, but also medium-sized and small settlements. High-order urban functions and borrowed size determine to some extent the development of Russian cities. The set of significant factors varies depending on the size of the city, but the availability (and number) of schools and the opportunity for children and

adolescents to do sports remains an important condition. For small towns (with a population of up to 10,000 people) the role of all the studied factors is important.

The use of the dynamic approach showed that the polycentricity of the urban system in the regions of the Central Federal District tends to increase, and the total number of urban residents is decreasing.

In our opinion, the Herfindahl – Hirschman index cannot be considered an exhaustive indicator and requires additional analysis or modification, which could be the subject of an independent study. Its value as an indicator of polycentricity of the urban system depends on the number of cities in the region and their size by number of inhabitants. It is necessary to understand that an equal indicator of polycentricity can be observed in regions with different system of cities. But in general, the Herfindahl – Hirschman index is widely used in economic geography, and its application, for example, in assessing the degree of monopolization of industries in the United States, occurs without adjustment for the number of firms in an industry.

The results of the study can be useful for scientists to further develop the ideas of using static and dynamic analysis to assess the reasons for the attractiveness of cities, justify the "borrowed size factor", determine the general trends in the formation of the system of cities. The practical value of the work lies in a better understanding of the principles of creating an attractive city for residents at different stages and conditions of its development, which can be used in the development of appropriate socio-economic programs at the city and regional levels.

In the further stages of the study it is planned to assess the impact of factors on the growth of cities in the dynamics, to analyze the trends of polycentricity of urban system of regions and to include in econometric models of distance variables to identify the "borrowed size".

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