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IMPACT OF SOCIAL INFRASTRUCTURE OBJECTS ON REGIONAL DEVELOPMENT

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Abstract

The infrastructure component holds an essential place in the assessment of economic growth. Among the infrastructure as a whole, we can distinguish a hard infrastructure, directly linked with the production and a soft infrastructure relating to social components, such as education, health, and government regulation. Nevertheless, the social infrastructure may have a significant impact on economic growth. The purpose of the research is to identify the impact of the social infrastructure components on several regions of the Russian Federation's gross regional product. The study uses econometric methods such as panel analysis with fixed and random effects. As a result of the research, the authors revealed soft infrastructure factors that affect the Russian regions' economies development. The influence of these components on the local economy has highlighted the specifics of the Russian Federation's distinct regions. The study results can be applied in programs of soft infrastructure design to promote steady economic development.

Keywords: Infrastructure development, regional economics, regional economic growth, social infrastructure

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1. Introduction

The sources of economic growth are one of the most popular areas of economic science research. In the modern economy, particular attention goes to public infrastructure, which is commonly addressed as bridges, roads, airports, irrigation systems and water mains, as well as other structures that provide economic growth (Eberts, 1990). However, this approach limits the scope of infrastructure to only those areas that directly affect the production process, leaving a significant part of activities that indirectly affect production intact.

Frischmann (2013) identifies four areas of infrastructure: transportation systems, communication systems, management systems (including government and the judiciary), and basic public services such as schools, sewers and water mains. Biktemirova et al. (2015) considered such infrastructure indicators as the water system, sewerage, heating network, school building, preschool institution, vocational education. The health of the population is influenced not only by the development of the medical care system but also by the infrastructure that allows maintaining a healthy lifestyle and physical activity (Gan et al., 2019). Medvedev (2016) defines education and health care as the essential infrastructural factors for developing the country. In (Yushkova et al., 2019), it is proposed to expand the concept of the regional system's spatial development based on the set of indicators describing the dynamics of changes in the quality of life in comparative assessments.

Despite a number of studies related to the importance of social infrastructure, there is a problem of evaluation of the social infrastructure impact on regional development. This work aims to identify the impact of social infrastructure on the dynamics of the gross regional product and to find the causes of the ambiguous impact of infrastructure factors on the economy.

2. Problem Statement

There are a number of Russian and Foreign studies assessing the impact of infrastructure on economic growth. Popov (2009) offers a three-factor production function, but his approach reflects participation in the production of a predominantly “solid” infrastructure, but cannot be applied in the analysis of soft and, especially, social infrastructure. Martin-Utrillas et al. (2014) present a model for the selection of infrastructure factors that are drivers for the sustainable development of regions. Liu et al. (2019) analyzed the development of infrastructure across Australian regions, using an error-corrected panel model. Goryainova et al. (2017) note that countries with a high level of economic development have an advanced growth at the health and education sectors, while in developing countries, these areas are given less importance. We believe that we can extrapolate this point of view to the region level.

By the term of social infrastructure, we assume a set of activities aimed at creating conditions for the economy's functioning and which are mostly non-tradable. Those are activities related to the public goods production, regulation of activity between economic agents.

As a classification of the social infrastructure, we can set out seven groups of factors which are:

- public administration;
- legal support and protection of property rights;
- quality of education and science;

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- quality of life and health care;
- cultural infrastructure development;
- freedom of access to information;
- technology development$
- freedom of the business environment.

Other works such as Liu and He (2019) further separate these factors into “hard” and “soft” public services. This understanding of the social infrastructure is necessary for a comprehensive study of the impact of infrastructure on economic growth. The production infrastructure has a relatively unidirectional effect and can be taken into account in economic models as one of the factors. The specificity of the social infrastructure is that:

- infrastructure is distinguished by a variety of factors with both tangible and intangible nature;
- it can have both a stimulating and inhibiting effect on production processes;
- factors of social infrastructure affect not only industrial production but also the production of infrastructure goods i.e. hard infrastructure;
- these factors may both interact and counteract each other;
- infrastructure factors may not interact with each other but have a joint effect on output.

Thus, an underdeveloped health care or education system can neutralise the positive impact of the effective legislative activity or the R&D incentive system, exerting a complex effect on human and embodied capital, and on the production of infrastructure benefits.

For the study, indicators of infrastructure development in the field of health care, education and sports were used. The choice of groups of indicators is due, firstly, to the objectivity of the data, while public administration indicators are relatively subjective, and their assessment is the topic of additional research. Vasilyeva et al. (2020) assessed the impact of a number of economic factors, including GDP growth on the Social Sector Institutional Development Index, of which the social infrastructure indicator is a component. Kalachevska (2018) in the set of indicators for the assessment of models for rural development includes budget healthcare expenses, hospital accessibility, budget expenses for education, however, the amount of expenses is an indicator that does not always correlate with the actual state of the infrastructure, so it is more rational to use indicators of the availability and accessibility of social infrastructure facilities. This approach is applied in the work of Miłek (2018) when analyzing the infrastructural development of Polish regions. Petronela (2016) provides data that more highly developed countries have a larger share of the cultural sector in GDP, noting the importance of cultural development for countries both in terms of national identity and in terms of generating income from tourism activities. Zilberstein et al. (2018) assesses the economic performance of the sports industry, but only on the example of the Southern Federal District and without reference to the development indicators of the entire macroregion.

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3. Research Questions

The approach of Eremeeva et al. (2019) is based on an analysis of the aggregate indicators of health, education, science and housing for 14 regions of the Russian Federation. This approach was proposed for ranking these regions by the level of social infrastructure development. In this case, the general picture of social infrastructure is determined, but the question remains, how exactly the factors of social infrastructure influence regional development. Our study's issue is to define the influence of individual factors on the regional economy, depending on the level of development of social infrastructure facilities. For the analysis of social infrastructure it is more rational to understand its impact as an index that can be used as a multiplier to the production function, which (abstracting from the production infrastructure) takes the form:

$$Y=AK\alpha L\beta\ I(1)$$

Where I is the coefficient of influence of social infrastructure, defined by mathematical mean of factors studied.

The coefficient of social infrastructure has a double influence on the production function. On the one hand, the services created by the objects of this infrastructure create added value and are a direct component of the GRP. These services have a qualitative impact on labour, ensuring its effective recovery. So the availability of effective health care and places to maintain physical fitness provides an improved quality of life and, higher productivity.

4. Purpose of the Study

The purpose of this study is to assess the influence coefficient of social infrastructure. We suppose it has a double influence on the production function. On the one hand, the services created by the objects of this infrastructure create added value and are a direct component of the GRP. These services have a qualitative impact on labour, ensuring their active recovery. So the availability of an adequate health care system and places to maintain physical fitness provides an improved quality of life and, higher productivity.

5. Research Methods

Since the influence of social infrastructure facilities can be interrelated and have a different effect on regions' economic development, depending on the degree of their development and specificity, it is rational to research in the regional context. In this regard, in a sample used, the regions were grouped according to the similarity of social infrastructure development.

During the study, we used the Louvain clustering method of the Orange data analysis package to identify regions similar in economic development, taking into account the impact of social infrastructure. For each of the identified clusters, we performed a panel analysis using the OLS method of Gretl package to find the infrastructure factors influencing clusters' economic development.

The initial model of the study implied that the impact on GDP growth is provided by capital gains and employment and some of the infrastructural factors. The assessment of the impact of the following

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social infrastructure objects on the economic development of the region implied the following basic formula:

lgGRP=lg_Capital+lg_Employed + Preschool+ Noned+ Collstud+ Univstud+ Colleges+Univstate+ Theatervis+ Museumvis+ Pop_per_doc+ Clinicsperday+ Clinics+ Pools+ Sportgrounds+ Gyms+ε (2)

where Preschool is the coverage of children aged 1-6 years by preschool educational institutions, per cent;

Noned is the number of children and adolescents aged 7-18 years, not studying in educational institutions, per 10,000 of the corresponding age;

Collstud is the number of students of state (municipal) institutions of secondary vocational education;

Univstud is the number of students at state (municipal) higher education institutions, thousand people;

Colleges is the number of state and municipal educational institutions of secondary vocational education (unit);

Univstate is the number of state (municipal) institutions of higher education (unit);

Theatervis the number of theatre visits thousand people;

Museumvis the number of museum visits thousand people;

Clinicsperday is the number of visits to the clinic per shift (one thousand visits per shift)

Clinics number of outpatient clinics (unit);

Pop_per_doc is the Population per doctor (person);

Pools is the number of swimming pools (unit);

Sportground is the number of plane sports facilities (thousand units);

Gyms is the number of gyms (thousand units);

l_Employment is the logarithm of the employees number;

l_Capital is the logarithm of the capital available;

l_GRP is the logarithm gross regional product;

ε is the noise that captures all other factors which influence the dependent variable other than the regressors.

We use the data for 65 regions of the Russian Federation from 2000 to 2010 as an empirical base of research. This period was chosen in connection with the most complete statistical data available for the regions of the country studied.

6. Findings

At the first stage of the study, the regions were grouped into clusters using the Louvain clustering method using Euclidean distance metrics with k-neighbours = 5. At the second stage, we performed multiple linear regression for each cluster. The Hausman and Breusch-Pagan tests showed that the pooled OLS method is optimal for all clusters. When analysing the studied clusters, we obtained ambiguous results: in each of the clusters, various groups of factors were recognised as significant. The results of the

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analysis are presented in Table 1. The significance of the variables is shown through the number *: *** show the significance of the variable at the 1% level, ** at 5% and * at the 10% level.

The model showed a sufficiently high correlation of the regressors with the resulting indicator which is confirmed by high coefficient of determination R^2. The second cluster in which the most developed regions of Russia are collected shows the maximum number of significant infrastructure variables and the maximum R^2. At the same time, the third cluster is consisted of less economically developed regions and characterised by a smaller number of significant variables and minimum determination rate.

In all clusters, capital showed itself to be a significant factor, while employment growth showed an ambiguous coefficient value. In the second and fifth clusters, this indicator gains a negative value, which shows the negative impact of the growth of employment on the economic growth of the regions. Such a result is possible with an overpopulation of regions or a lack of capital resources to cover the employment growth. The number of children and adolescents who are not covered by the education system has the expected negative impact and is also significant in the second and fifth regions with general overpopulation.

Table 1. Results of the panel analysis on the studied clusters

Cluster number	Regions in the cluster	Significant Variables	Variable		R^2
1	Kamchatka Krai Kostroma region Novgorod region Oryol Region Pskov region Kabardino-Balkaria region Mari El Republic Republic of North Ossetia The Republic of Khakassia	const	-4,70793	***	0,932364
		Collstud	-0,0316500	**	
		Univstud	0,0231437	***	
		Colleges	-0,0194839	***	
		Pools	-0,0109327	***	
		Univstate	-0,0533544	**	
		l_Capital	1,33770	***	
		l_Employment	-3,42238	***	
2	Moscow St. Petersburg Krasnodar region Moscow region Sverdlovsk region Tyumen region Khanty-Mansi Autonomous Area Yamalo-Nenets Autonomous District Republic of Tatarstan	l_Capital	1,05211	***	0,993084
		Preschool	-0,0290032	***	
		Noned	-0,0058122	*	
		Collstud	0,0279781	***	
		Univstud	0,00500786	***	
		Colleges	-0,0090743	**	
		Theatervis	-0,00025359	**	
		Museumvis	8,52392e-05	***	
		Pools	-0,0037676	***	
		Sportground	0,294022	***	
		Gyms	1,11571	***	
		Clinics	-0,0004587	*	
3	The Republic of Ingushetia Magadan Region Republic of Adygea Altai Republic Republic of Kalmykia Karachay-Cherkess	const	-1,95502	**	0,856552
		l_Capital	1,11318	***	
		Clinicsperday	0,180672	***	
		Preschool	-0,00852801	***	
		Univstud	-0,0744310	***	
		Clinics	-0,0115777	***	

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4	Republic Tyva Jewish Autonomous Region Nizhny Novgorod Region Irkutsk region Samara Region Krasnoyarsk region Perm region Rostov region Chelyabinsk region Republic of Bashkortostan	const	-8,39821	***	0,955224
		Univstud	0,00289455	***	
		Museumvis	0,00037352	***	
		Univstate	-0,0475793	***	
		l_Employment	0,833344	***	
		l_Capital	1,09429	***	
5	Saha Republic Khabarovsk region Yaroslavskaya oblast Stavropol region PrimorskyKrai Murmansk region Voronezhregion VologodskayaOblast	const	2,44615	**	0,938335
		l_Employment	−0,899875	***	
		l_Capital	0,854467	***	
		Preschool	0,0383252	***	
		Noned	−0,005878	***	
		Univstud	0,0276911	***	
		Colleges	0,00738754	***	
		Sportground	−0,349043	***	
		Gyms	0,768085	***	
		Clinics	−0,00070647	***	
6	Volgograd region Kemerovo region Leningrad region Novosibirsk region Orenburg region Saratov region Sakhalin region KomiRepublic	const	-3,44924	***	0,944547
		l_Employment	0,987027	***	
		l_Capital	0,940452	***	
		Collstud	-0,0297206	***	
		Univstud	0,00925692	***	
		Colleges	-0,0137815	**	
		Theatervis	-0,0023450	***	
		Pop_per_doc	-0,00725079	***	
7	Altai region Belgorod region Tver region Lipetsk region Omsk region Tomsk region The Republic of Dagestan Udmurtia	const	−5,93261	***	0,951751
		l_Capital	1,47877	***	
		Clinicsperday	−0,00745182	***	
		Collstud	0,0372087	***	
		Univstud	−0,00254090	***	
		Colleges	−0,0437777	***	
		Pop_per_doc	−0,00350636	***	
		Sportground	0,170183	***	
8	Amur region Astrakhan region Kirov region Penza region Ryazan Oblast Tula region Transbaikalregion	const	-7,56576	***	0,964730
		l_Employment	0,613605	***	
		l_Capital	1,20123	***	
		Clinicsperday	0,0207881	***	
		Collstud	-0,0278110	***	
		Gyms	-0,254404	***	

Preschool has a negative impact on the second and third clusters, but it has a positive effect in the fifth one. It might happen because in regions of the 2nd cluster with an increase of population, the coverage of children by preschool institutions falls or remains unchanged, which may reduce the employment opportunities for a certain part of the population. In the regions of the 3rd cluster, the situation is somewhat different: the enrollment of children in preschool institutions is increasing, but the total population is declining, which makes preschool institutions unremunerative. At the same time, in regions of the 5th

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cluster, both an increase in the population and an increase in the enrollment of children to the preschool institutions are observed, which makes it possible to increase the participation of parents in the GRP production.

The indicator of the college students number takes a negative value in the clusters 1, 6 and 8, which may be evidence of a decrease in the number of college students, both as a result of the general demographic situation and due to lower incomes and the possibility of changing jobs for those with secondary education. A positive value in clusters of 2 and 7 requires more detailed study but most likely is associated with higher employment opportunities for people with secondary education.

Univstud takes a positive value in clusters 1, 2, 4, 5, 6 and negative in clusters 3 and 7. It can be explained by the migration of students to regions with a more developed higher education system, while graduates tend to remain in the region of their studies, which slows down the development of the region of the student origin. The number of colleges takes a positive value only in cluster 5, taking a negative value in clusters 1, 2, 6 and 7. It may be because in most regions colleges receive a residual basis, with students favouring a higher education.

The number of state universities was recognised as significant in the 2nd and 4th clusters, in both, it takes negative values, this may show an unsatisfactory financial situation in these universities, relatively weak integration with business, and substantial public funding needs.

The number of viewers of theatres turned out to be significant only in clusters 2 and 6 and in both took a negative value. It may be due to the relatively low payback of theatres. At the same time, the number of museum visitors has a positive effect on the economy of 2nd and 4th clusters. It is most likely due to high tourism activity in these regions.

The variable of Clinic quantity takes a negative value in all clusters where it was recognised as statistically significant: 2, 3 and 5.Itis due to the reduction in quantity and growth in the size of clinics in the regions.

Particular attention should be paid to the variable population per doctor. In both clusters, where this variable was found to be significant, the negative effect of the variable on GRP is visible. It is explained by the fact that with an increase in the load per 1 doctor, the time for communicating with the patient and diagnosing his condition decreases thus the quality of the services declines.

The capacity of the clinic, estimated through the number of visits per day, was significant in clusters of 3, 7 and 8, while in 3rd and 8th clusters it takes a positive value, and in 7th it is negative. In our opinion, the impact of this indicator should be considered in conjunction with the previous value: if the quantity and quality of doctors increases, a positive result from enhancing the capacity of clinics may have a positive effect on GRP. If, as in the 7th region, an increase in the load of 1 doctor is observed, this may indicate a decrease in the quality of service and worsening the population health what affect the socio-economic development of regions. For more accurate studies of the effect of this variable, additional research is needed to clarify the state of health care in a particular region.

The Pools indicator turned out to be significant only in 1st and 2nd clusters, while in both it takes a negative value. Such a situation can be explained by the fact that the maintenance of the pools is a rather expensive service and a relatively small number of people regularly swim. The indicator of open sports grounds turned out to be significant in 2nd, 5th, 7th clusters, while in the5th cluster it takes a negative

value. It is because in these regions the number of sports grounds did not change during the study period or grew insignificantly. The Gyms variable showed significance in 2nd, 5th and 8th clusters, occupying a fairly high weight. In contrast, in 8th cluster the indicator takes a negative value, presumably because of poor sports infrastructure and, unlike other clusters, these regions experienced a sharp decline in the number of gyms in 2010, which indicates problems in this segment.

7. Conclusion

This work represents the initial stage of identifying the impact of social infrastructure on the economic development of regions. The study confirmed the hypothesis of the relationship between the economic development of regions and social infrastructure, showed the main failures in the development of social infrastructure in the development of regions. The current model's main limitations are the old data and the insufficient length of the time series for building a model capable of predicting the consequences of the development of particular social infrastructure objects. It is necessary to study the effect of lags on the model's indicators, since most of the studied factors' influence does not appear at once, but, after a certain amount of time. However, the current model makes it possible to analyse the specifics of the regions under study, find the influence of certain infrastructural factors, and develop economic policy measures to adjust the influence of social infrastructure factors on the regional economy. The further stages of the study will be the development of an accurate model for forecasting qualitative regional economic growth and the influence of social infrastructure factors on individual components of the production function, taking into account expanded models of economic growth.

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