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Effectiveness of Public-Private Partnership Projects During the COVID-19 Pandemic

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ABSTRACT

The **purpose** of the study is to assess the effectiveness of public-private partnership (PPP) projects during the COVID-19 pandemic, taking into account the specificities of the industry. The **empirical research base** included the main characteristics (contract price, federal district of the project, customer, general contractor, project start period, project start year, project deadlines, price reduction during project implementation, application security, contract security and type of activity) of 144 regional investment projects. The **research methodology** included mathematical modeling using the DEA (Data Envelopment Analysis) data convolution method, on the basis of which an efficiency index was assigned to each PPP project from 0 to 1. The study **concluded** that prior to the COVID-19 pandemic, regional investment projects received more funding; after the start of the COVID-19 pandemic, the implementation time of regional investment projects has increased, the contract value more often changes downwards during the project implementation; and the average support for a project application has increased. The efficiency of implementation of regional investment projects, calculated using the DEA method, was reduced. The results obtained will be useful to private investors and government authorities when implementing joint projects to improve their efficiency.

Keywords: public-private partnership (PPP); investment project; pandemic; DEA; mathematical modeling; efficiency; regional investment projects; economic support measures

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INTRODUCTION

Public-Private Partnership (PPP) is increasingly prevalent because it protects the country's long-term growth through significant improvements in infrastructure in many developing countries. It should be noted that in a crisis situation, the government to attract the most efficient resources and uses various mechanisms for attracting them. The public policy in the regional investment projects of PPP has changed, such as the COVID-19 pandemic has deteriorated the financing of projects by the state and there is a need to attract additional financial resources of private to combat the pandemic and maintain socio-economic well-being.

Changes in public policy during the pandemic studied by a number of authors. Thus, V.N. Titov and A.M. Korshunov [1] analyzed the issues of the transformation of state administration during the pandemic, A.A. Smirnov [2] considered the question of support of small and medium-sized companies in the crisis period of the pandemic, B.I. Perhov and O.V. Gridnev [3] studied the impact of the pandemic on the health sector, E.A. Badeeva, Y.V. Malakhov, M.Y. Tarasov [4] evaluated the economic consequences of the pandemic. However, for the Russian economy, the issues of changing the effectiveness of PPP projects during the pandemic are considered for the first time.

The purpose of the study is to evaluate the effectiveness of the regional investment projects of the PPP in the context of the pandemic. The empirical research base included the main characteristics (contract price, federal district of the project, customer, general contractor, project start period, project start year, project deadlines, price reduction during project implementation, application security, contract security and type of activity) of 144 regional investment projects. The research methodology included mathematical modeling using the DEA (Data Envelopment Analysis) data convolution method.

LITERATURE REVIEW

When it comes to large investment projects, the public-private partnership mechanism, which enables large-scale projects to be implemented with the participation of both the state and private investors, cannot be ignored. Domestic and foreign scientists studied this mechanism, identifying its strengths and weaknesses. The authors B.J. Dykes, C.E. Stevens and N. Lahiri [5] concluded that public-private partnerships enable the state to reduce risks and costs, transfer responsibility to private investors and increase the cost-effectiveness of infrastructure projects. Russian authors A.V. Prolubnikov and A.S. Rumyantsev [6] justified the need for the development of the mechanism of PPP in the Russian Federation during the pandemic of COVID-19, as it is effective for attracting investments in large investment projects.

Other authors, A. Sadegni, O. Barati, P. Bastani [7], sharing this view, after examining private investment in Iran, consider that the PPP mechanism needs detailed PPP regulatory legislation to maximize its effectiveness. A.D. Krasnov [8] has a similar point of view, who noted that the COVID-19 pandemic acted as a catalyst for changing the regulatory and legal framework for regulating the PPP sphere, as well as the change of local regulatory acts and contract structures: now contracts prescribe more force majeure situations, making projects implemented with the help of PPP more protected and reliable.

During the pandemic period, government policy on regional PPP projects changed significantly.

Firstly, the PPP mechanism has extended to the field of medicine. The most massive specific examples of the functioning of the PPP mechanism during the COVID-19 pandemic were projects in the field of vaccine development, production and distribution of personal protective equipment, medical equipment, as well as projects in diagnostic centers and intensive care units [9]. The authors D. Baxter and B. Casady [10] discovered that PPP initiatives improve the synergy between public finance and corporate (private) capital to address systemic issues while increasing their effectiveness in the production of important health items. At

the same time, they studied the impact of force majeure circumstances on the implementation of investment projects using PPP, proposed a model of management of unexpected risks on the example of the coronavirus pandemic.

S. Duijn and co-authors [11] based on an analysis of PPP projects in Africa during the COVID-19 pandemic, found that the involvement of private clinics in government contracts for the treatment of COVID-19 patients was effective and helped to reduce the negative effects of the COVID-19 pandemic in a number of African regions.

In the UK, an example of this is the PPP project for the provision of personal protective equipment.

Another example of the implementation of PPP during the pandemic is the pandemic monitoring project for wastewater in Israel.[1] The contract was concluded between the Government of Israel and Pfizer. The project also tested the vaccine against COVID-19.[2]

We can also give an example of the PPP project implemented in Austria, which has resulted in the development of an application that allows monitoring the network of contacts of the COVID-19 carrier.[3]

Secondly, sectoral priorities for the allocation of public funding have changed. Researchers D. Baxter and B. Casady [12] revealed that after the COVID-19 pandemic, new trends have emerged in the implementation of public-funded investment projects and proposed an author-based methodology for project classification in order to determine the priority of public support. Projects were divided into several categories depending on the amount of additional financial support required by the government: projects whose financial stability has not been affected by the COVID-19 pandemic; projects which suffered minimal financial losses as a result of the pandemics; projects requiring temporary public support; projects that cannot continue without substantial financial support; and projects which cannot continue even with significant amount of public support. They consider that in the context of the pandemic, it is necessary to determine the priority of financing of PPP projects, as well as the maximum permissible amounts of project financing for each category due to the reduction of tax revenues to the budget.

Thirdly, during the pandemic, the procedure for coordinating investment projects[4] is simplified to improve the speed and coordination of both public and private entities. However, as some researchers have noted [9], the fundamental disadvantage of such a method is the lack of transparency in contracts made under the simplified scheme. For example, some of the contracts did not pass the tender procedure, which allowed to shorten the time of implementation of PPP, but the principle of competitive tendering and optimum expenditure of the state budget was not observed. The authors note that in order to ensure the effectiveness and transparency of implementation of PPP projects, the UN has developed a special standard for the management of projects implemented through the PPP mechanism.[5] The document sets out the principles (participation, transparency, integrity, accountability, fairness and effectiveness) under which investment projects involving the government and private companies should be implemented.

In general, the authors note that the synergy of the state and business allows more

[1] National Library of Medicine. National Scale Real-Time Surveillance of SARS-CoV-2 Variants Dynamics by Wastewater Monitoring in Israel. URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC 9227326/ (accessed on 20.12.2023).

[2] Israel Journal of Health Policy Research. Israel's rapid rollout of vaccinations for COVID-19. URL: https://ijhpr.biomedcentral.com/articles/10.1186/s13584–021–00440–6 (accessed on 27.12.2023).

[3] National Library of Medicine. Digital contact-tracing during the Covid-19 pandemic: An analysis of newspaper coverage in Germany, Austria, and Switzerland. URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC 7857553/ (accessed on 16.12.2023).

[4] Department of Health & Social Care of the UK. The supply of personal protective equipment (PPE) during the COVID-19 pandemic. URL: https://www.nao.org.uk/wp-content/uploads/2020/11/The-supply-of-personal-protective-equipment-PPE-during-the-COVID-19-pandemic-Summary.pdf (accessed on 28.11.2023).

[5] United Nations Economic Commission for Europe. Guidebook on Promoting Good Governance in Public-Private Partnerships. URL: https://unece.org/DAM/ceci/publications/ppp.pdf (accessed on 22.12.2023).

successfully to overcome the difficulties of the COVID-19 pandemic. P. Love [13] analyzed the dynamics of transport infrastructure investment projects using PPP in Australia, demonstrated the effectiveness of the PPP mechanism and developed recommendations for improving the public procurement system. Russian researchers T.V. Volkova and L.V. Rachlin [14] note that the PPP mechanism is one of the main tools for mitigating the effects of the COVID-19 pandemic, supporting business activity and the development of the national economy. It allows to implement complex infrastructure projects with the involvement of business structures of various sizes.

Thus, we conclude that the COVID-19 pandemic has contributed to the development of the practice of using PPP in investment projects, as the synergy of the government and business allows more effectively to overcome the effects of the global pandemic. At the same time, new projects in the PPP region during the COVID-19 pandemic, as a rule, are not traditional examples of public-private partnership contracts and are aimed at urgent resolution of the problems of the pandemic. Author assumes that policy in the context of the pandemic for PPP projects has also changed.

METHODOLOGY OF RESEARCH

Evaluation of project effectiveness is based on the calculation of standard economic efficiency (NPV, IRR, PI), index calculation.

The authors of J. Munoz-Jofre, S. Hinojosa, A. Mascle-Allemand, J. Temprano [15] developed a special index to measure the effectiveness of PPP projects in the field of drainage and water supply on the example of the PPP of Latin America. Evaluation of the effectiveness of PPP projects may also be based on economical and mathematical modeling. The DEA (Data Envelopment Analysis) method was developed in the 1970-s and is used to analyze the effectiveness of social and economic processes. The method allows consideration of many factors and their impact on the resulting indicator and is used to evaluate the effectiveness of PPP projects. The DEA model is used to evaluate companies participating in PPP projects.

As noted by J. Wang and Y. Lin in their study [16], the model is used to complex assess the performance of a company for the purposes of a specific PPP project, as well as to assess technical and financial effectiveness. The authors developed and tested a model for Chinese companies, as well as recommendations for companies applying for participation in PPP projects.

This method is also used in the industry assessment range. For example, G. Xiong, Y. Chai, y. Cao, X. Wang [17] described the use of DEA methodology to analyze the investment effectiveness of PPP projects in agriculture, also used the convolution regression model to match results. As a database, the authors use the characteristics of 24 investment projects implemented in China. The results of the study identified the provinces of China where the most effective implementation of agricultural investment projects with government participation. A similar study was conducted on the example of India by V. Agarwal [18], who analyzed a range of investment projects in different regions of India using mathematical modeling and the DEA method. According to the results of the study, participation of private companies allows to reduce the risks of investment projects, use of more modern technologies, and also increases the effectiveness of regional investment projects. It was noted, however, that the use of the PPP mechanism in India entails additional transaction costs, such as disruption of management coordination, prolonged project coordination due to insufficient development in the country of the relevant infrastructure.

Also, the DEA methodology has been used in China to evaluate the effectiveness of power projects, to assess the impact of "green financing" on the efficiency of such projects. The authors Z. Wang, X. Wang [19] have demonstrated the relationship between the effectiveness of the project and the level of integrated development of the territory in which it is implemented, with ambiguous results of the impact of "green

financing" on the efficiency of projects: in the eastern part of the country its use led to improved project efficiency, and in the central region — to a decrease.

Investigators B. Bae and C. Seo [20] conducted an analysis of the relationship between the effectiveness of the implementation of road infrastructure investment projects, as well as its safe operation and the use of the PPP mechanism in the project. Thus, through the analysis of empirical data collected in South Korea, using DEA and panel regression, it was found that there was a positive impact between the use of PPP and project effectiveness, as well as safety in subsequent operation. The authors also developed recommendations for countries to use PPP in the construction and maintenance of roads.

The DEA model was applied by the authors D. Yang, L. Li, T. Notteboom [21] to assess the efficiency of ports based on the share of government and private companies in their activities on the example of China. The port capacity and market share in the port region were studied. As the researchers note, increased participation of private companies leads to increased capacity and market share, however, difficulties in interacting with private companies can complicate port operations, resulting in additional costs. A similar study was conducted by P.F. Wanke and C.P. Barros [22] to assess the impact of PPP mechanisms on the activities of state-owned ports in Brazil. Thus, the results of the study showed that ports using the services of private companies are more efficient in terms of shipment volumes, the use of modern technologies, and the management of logistics chains, which proves the effectiveness of the PPP mechanism for the activities of the ports of Brazil.

The DEA methodology is also used in the preparation of logistics performance indices for countries. Based on the results of the analysis, the rating of countries with the benchmark is drawn up. The methodology is based on the DEA data analysis method, which takes into account many factors both at the state level and the impact of private companies on the provision of services and their impact on the end result. This method was developed by the authors P.K. Gudavalleti, S. Singh, O.S. Vaidya [23] and can be used for the complex evaluation of an investment project both in the development and implementation stage.

Thus, it is possible to draw a conclusion about the applicability of this method for evaluating the effectiveness of PPP projects, and we will use it, describing its mathematical component below. The method allows to evaluation the influence of several factors on the resulting indicator. Within the framework of this method, each analyzed object i has k input parameters and m output parameters. Column vector is formed for each object. The next task is mathematical programming, in which the measure of efficiency for each i-ro object is sought. This problem is solved again for each object separately, the scheme of application of the DEA method in the present study is presented on *Fig. 1*.

In our study as input parameters were chosen the procurement of the total price and the provision of the contract, as the output parameters — the final price of the project.

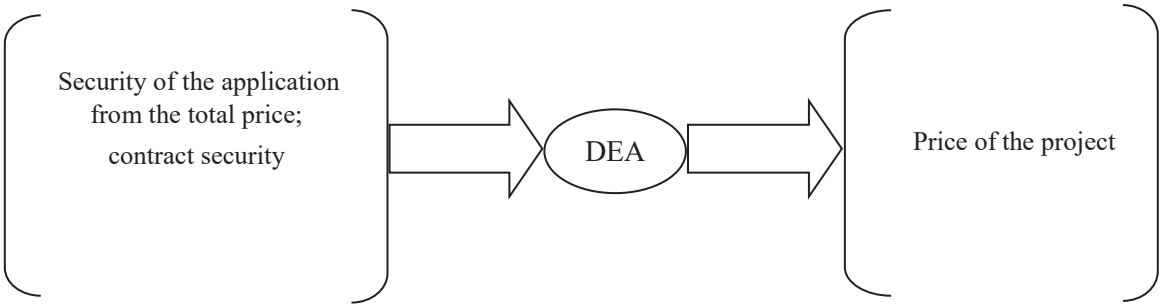

Fig. 1. **DEA BCC Inputs and Outputs or VRS Model**

Source: Author's calculations.

Table 1

Characteristics of Regional Investment Projects (Price, Term, Application Security, Price Reduction) Before the Pandemic and During the Pandemic COVID-19

Before COVID-19				
	Price	**Term**	**Application Security**	**Price Reduction**
Mean	8 809 877 534	9,9	100 945 249	1
Min	1 735 313	0	0	0
Max	102 752 500 000	117	513 762 500	17
During COVID-19				
	Price	**Term**	**Application Security**	**Price Reduction**
Mean	8 012 451 173	11,1	141 791 621	3.5
Min	4 600 000	0	0	0
Max	105 900 000 000	112	2 959 662 220	39

Source: Developed by the authors on the basis of a dataset of regional projects.

RESULTS OF THE STUDY

Regional investment projects from different subjects of the Russian Federation were taken as the empirical basis of the study, a total of 144 regional investment projects were analysed. Information about them is taken from open sources: official websites of the Ministry of Economic Development of the Russian Federation,[6] regional ministries,[7] investment portals of Russian subjects[8] etc. Information on the distribution of budget funds, public procurement is contained on the official website of the Unified Information System in the procurements sphere.[9]

The following indicators were collected in the regional project set: contract price, federal district of the project, customer, general contractor, project start period, project start year, project deadlines, price reduction during project implementation, application security, contract security and type of activity. The set of projects was divided into two parts: projects started before the pandemic and during the pandemic, the chronological period of start of the selected projects covers the period from 2015 to 2021.

In the first phase, a comparative analysis of the characteristics of the projects (price, term, application security, price reduction) was carried out before the start of the COVID-19 pandemic and during the pandemic. Its results are presented in *Table 1*.

Comparing the periods before and during the pandemic, it can be concluded that the average price of contracts has decreased slightly since the onset of the COVID-19 pandemic: a decrease of 9% in relative terms. Before COVID-19 the project with the highest price was implemented in the Siberian Federal District (in Krasnoyarsk Territory "Project to create the latest production of railway freight transport systems with light body made of aluminum alloys" at the order of the Ministry of Economic Development and Investment Policy of Krasnoyarsk Territory, implementation is planned for 10 years in the period from 2018 to 2028). After pandemic starts — in the North-West Federal District (project commissioned by the Government of the Murmansk Region "Development of

[6] Ministry of Economic Development of the Russian Federation. URL: https://www.economy.gov.ru/ (accessed on 25.12.2023).

[7] Ministry of Investment and Development of the Sverdlovsk Region. URL: https://mir.midural.ru/ (accessed on 25.12.2023).

[8] Kaluga region investment portal. URL: https://investkaluga.com/ (accessed on 25.12.2023).

[9] Unified information system in the procurement sector. URL: https://zakupki.gov.ru/epz/main/public/home.html (accessed on 25.12.2023).

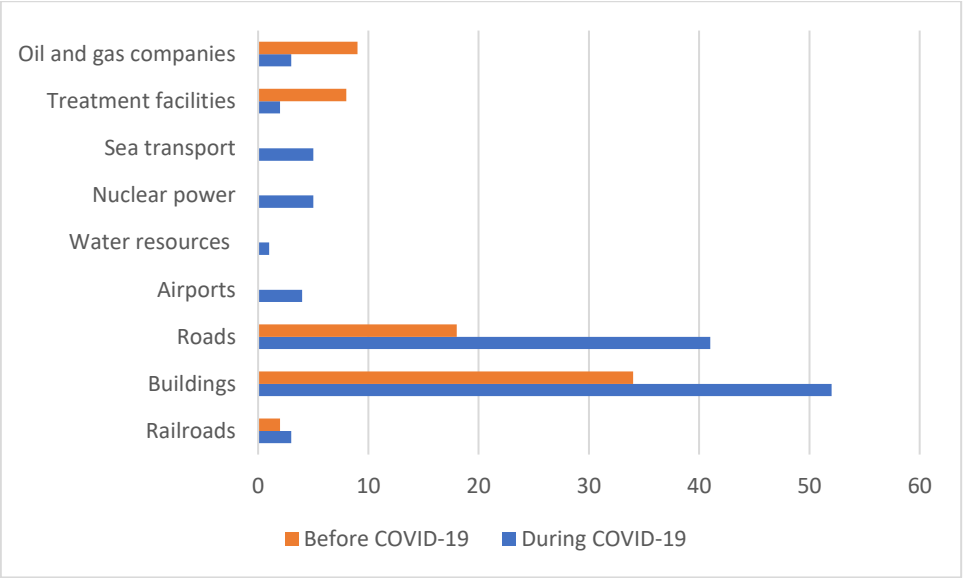

Fig. 2. **Number of Regional Investment Projects Initiated Before and During the COVID-19 Pandemic**
Source: Author's calculations.

Kovdor Mining and Enrichment Combination", which is planned for implementation over 10 years in the period from 2022 to 2032). During the pandemic, PPP implementation rates also increased by 12% in relative terms, moreover, the practice of lowering the project price has become more common since pandemic start.

Fig. 2 shows the change in the number of regional investment projects by sectors (sea transport, nuclear power, airports, roads and buildings (including manufacturing complexes) before and during the pandemic.

It is also important to analyse the average term of regional investment projects. *Table 2* shows the average project implementation time (years) prior to the pandemic and during it. It can be noted that since the start of the COVID-19 pandemic, the duration of implementation of regional investment projects has significantly increased. With a more detailed

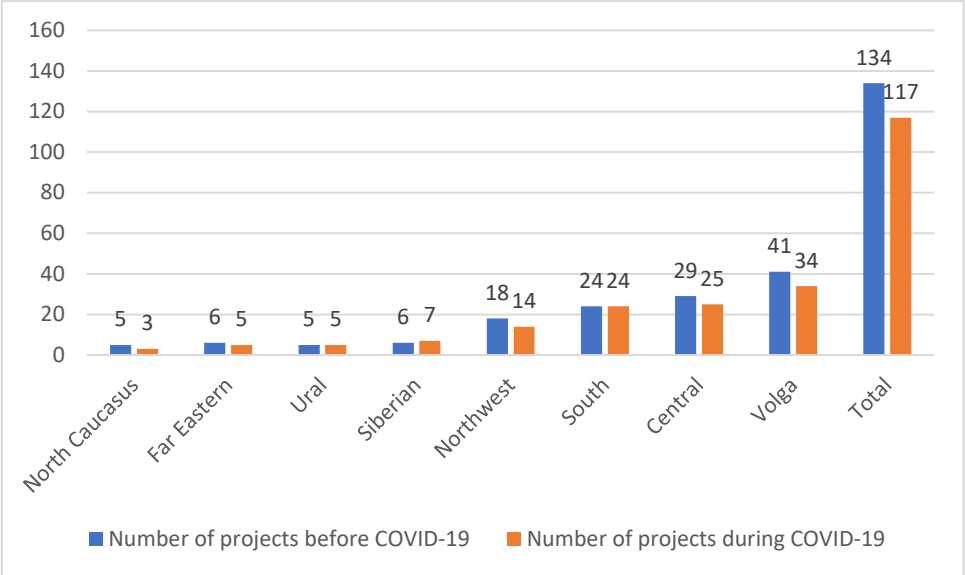

Fig. 3. **Distribution of Projects by Federal District Before and During the COVID-19 Pandemic**
Source: Author's calculations.

Table 2

Average Lead Times for Regional Investment Projects Before and During the COVID-19 Pandemic

Project Industry	Average project implementation time to COVID-19, years	Average project implementation time during COVID-19, years
Railroads	15	9.3
Buildings	3.7	6.4
Roads	2.2	4.2
Airports	17	19.5
Water resources	14	18
Nuclear power	20	26
Sea transport	3.2	4.2
Treatment facilities	3	4.5
Oil and gas companies	11	8
Total	9.9	11.1

Source: Developed by the authors on the basis of a dataset of regional projects.

Table 3

Evaluation of Project Effectiveness by Federal District Before and During the COVID-19 Pandemic

Federal District	Average value of DEA after COVID-19	Average value of DEA during COVID-19
Central	1	1
South	0.65	0.54
Northwest	0.49	0.47
Far Eastern	0.32	0.25
Siberian	0.28	0.23
Ural	0.21	0.17
Volga	0.17	0.15
North Caucasus	0.14	0.13
Total	0.41	0.37

Source: Developed by the authors on the basis of a dataset of regional projects.

Table 4

Evaluation of Project Efficiency by Type of Activity

Type of activity	Average value of DEA indicator before COVID-19	Average value of DEA during COVID-19
Railroads	0.56	0.34
Buildings	0.48	0.44
Roads	0.64	0.49
Airports	0.66	0.46
Water resources	0.5	0.5
Nuclear power	0.56	0.56
Sea transport	0.55	0.43
Treatment facilities	0.88	0.83
Oil and gas companies	0.29	0.29
Total	0.57	0.48

Source: Developed by the authors on the basis of a dataset of regional projects.

analysis it becomes clear that the duration of implementation of projects in the framework of the construction of roads, buildings (including production complexes), as well as treatment facilities has increased.

We also analyzed the number of projects in the range of the territorial location of their implementation (federal districts), presented in the *Table 3*. Thus, the largest number of projects registered in the Volga Federal District, the total amount of projects — 118.4 bln rubles.

A fairly large number of projects are being implemented in the Central Federal District for a total amount of 85.9 bln rubles and in the Southern Federal District — the total number of implemented projects amounted to 260.2 bln rubles. It can be noted that the largest number of projects are implemented in the Central Federal District, the total cost of regional investment projects is higher in the Southern Federal District.

As a result of the analysis, *Tables 3* and *4* presented average values of the effectiveness of the DEA regional investment projects by their administrative-territorial location and by activities.

The data from *Table 3* shows that the highest indicators are in the projects implemented in the Central Federal District; also, high values in projects from the Southern and North-Western Federal Districts. Lowest performance indicators for projects in the North Caucasus, Volga and Ural Federal Districts. In accordance with the DEA methodology after the start of the COVID-19 pandemic, the projects implemented in the Central Federal District (1) showed the greatest effectiveness; high values in the projects from the South (0.54) and North-West (0.47) Federal Districts, with the lowest performance indicators in the North Caucasus (0.13), Volga (0.15) and Ural (0.17) Federal Districts.

When conducting a complex analysis of the effectiveness of regional investment projects, we can note that the efficiency of projects in the Central Federal District has not been reduced, which can be explained by the greatest efficiency

in the fight against the pandemic in the region, as well as the activity of the business structures of the region. A slight decrease in efficiency was recorded in the Northwest, Ural, Volga and North Caucasus Federal Districts. Furthermore, the effectiveness of investment projects has declined in the Far Eastern and Siberian Federal Districts, and the Southern Federal District has suffered the most.

When it relates to regional investment projects, it is significant to note that the most efficient projects to date are in the construction of treatment plants (0.83), while the least efficient are in the field of oil and gas companies (0.29). The results of the study are presented in *Table 4*.

In the analysis of the distribution of the effectiveness of regional investment projects before and after the coronavirus pandemic by type of activity, it can be noted that the most stable was the type of activities "building facilities", construction and maintenance of oil and gas companies, treatment facilities, projects in the field of nuclear energy and water resources. At the same time, efficiency was significantly reduced in the area of transport infrastructure: railways, roads and airports.

CONCLUSION

Thus, on the basis of the analysis of PPP investment projects, the following trends were identified:

1. During the pandemic, the sectoral orientation of PPP projects changed: a new area of partnership was added — the medicine (research, production of equipment and consumables, provision of services). Similar results were obtained by the researchers T.N. Yudina and A.M. Balashov [24], who concluded that the coronavirus pandemic served as a significant driver for the implementation of PPP projects in the field of medicine, due to the sharp increase in the need for medical development, supply of medical equipment and the provision of related services.

2. As a result of the COVID-19 pandemic, transport infrastructure investment projects (railways, roads, airports) suffered the most. This is due to restrictions on freedom of movement due to the severe epidemiological situation. Thus, the results of our study coincide with the results by M.A. Valishvili [25], who noted that as a result of the COVID-19 pandemic, transport infrastructure projects were more affected by the restrictions imposed. Similar conclusions were by the authors I.G. Kurilchenko and T.A. Pantina [26]. They concluded that the pandemic affected all types of transport services, including water transport, and that investment projects in the above-mentioned sectors slowed.

3. Regional investment projects have increased by an average of one year. The extension of the implementation deadlines is due to the restrictions imposed, as noted by the researchers E. Simen and M.Y. Sheresheva [27] in relation to China, the authors developed recommendations to increase the permissible duration of implementation of already started investment projects in the event that participants provide relevant evidence of the impossibility of completing the project within the specified deadline, which is due, primarily, to the pandemic.

4. The effectiveness of implementation of regional investment projects decreased, the worst quality deterioration was recorded in the Southern Federal District. The decrease in efficiency was also linked to the above-mentioned difficulties that emerged during the pandemic. The authors D. Larasati, N. Ekawati, S. Triyadi [28] concluded that as a result of the socio-economic consequences of COVID-19 the effectiveness of construction projects decreases significantly in the later stages of their implementation, as demonstrated by the data set of building projects in Indonesia.

5. The average cost of the contract has decreased by 900 mln rubles, also 3 times more often a decrease in the cost of a contract in the process of implementation of a regional investment project. This aspect, according to the authors, is linked to increased expenditure on the health sector, including the necessary research. This has led to a decrease in funding for a number of investment projects in areas other than medicine and epidemiological control.

6. Moreover, the provision of the application for the investment project increased by 41 mln rubles. The measure is linked to increased risks associated with the implementation of large regional investment projects, as well as the uncertainty created during the pandemic.

The aforementioned results are explained by the complex epidemiological scenario created by the COVID-19 pandemic, which has resulted in a challenging socioeconomic situation both globally and in Russia. At the same time, it is important focusing on that relevant measures have been adopted in our country to support corporate activity, allowing us to ensure the long-term sustainability of investment projects with minimal efficiency losses. It should be noted that the PPP mechanism was actualized as a result of the pandemic and proved its effectiveness in conditions of uncertainty and force majeure. It is also evident that further public-private partnerships are required to ensure long-term economic development, which will contribute to the strengthening of national sovereignty.

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REFERENCES

1. Titov V.N., Korshunov A.M. Public management during the threat of the spread of COVID-19. *Problemy sotsial'noi gigieny, zdravookhraneniya i istorii meditsiny = Problems of Social Hygiene, Public Health and History of Medicine.* 2021;19(S 1):804–807. (In Russ.). DOI: 10.32687/0869–866X-2021–29-s1–804–807
2. Smirnova A.A. Measures of state support for small businesses during the COVID-19 pandemic in Russia. *Ekonomika, predprinimatel'stvo i pravo = Journal of Economics, Entrepreneurship and Law.* 2021;11(2):285–298. (In Russ.). DOI: 10.18334/epp.11.2.111588
3. Perkhov V.I., Gridnev O.V. COVID-19 pandemic lessons for policy in the field of public health. *Sovremennye problemy zdravookhraneniya i meditsinskoi statistiki = Current Problems of Health Care and Medical Statistics.* 2020;(2):206–222. (In Russ.). DOI: 10.24411/2312–2935–2020–00043
4. Badeeva E.A., Malakhova Yu.V., Tarasov M. Yu., Barbashova S.A. Macro- and microeconomic consequences of overcoming the COVID-19 pandemic for the Russian economy. *Modeli, sistemy, seti v ekonomike, tekhnike, prirode i obshchestve = Models, Systems, Networks in Economics, Engineering, Nature and Society.* 2021;(2):5–29. (In Russ.). DOI: 10.21685/2227–8486–2021–2–1
5. Dykes B.J., Stevens C.E., Lahiri, N. Foreignness in public-private partnerships: The case of project finance investments. *Journal of International Business Policy*. 2020;3(6):183–197. DOI: 10.1057/s42214–020–00051-z
6. Prolubnikov A.V., Rumyantsev A.S. Public-private partnership in the COVID-19 pandemic context. *Izvestiya Sankt-Peterburgskogo gosudarstvennogo ekonomicheskogo universiteta.* 2021;(5):75–79. (In Russ.).
7. Sadeghi A., Barati O., Bastani P., et al. Feasibility of implementing public-private partnership (PPP) in the development of hospital services and optimizing resource allocation in Iran. *Cost Effectiveness and Resource Allocation*. 2020;18(1):25. DOI: 10.1186/s12962–020–00221-z
8. Krasnov A.D. Public-private partnership in the Russian Federation amidst a pandemic. *Kreativnaya ekonomika = Journal of Creative Economy.* 2021;15(9):3523–3534. (In Russ.). DOI: 10.18334/ce.15.9.113239
9. Tille F., Pantelli D., Fahy N., et al. Governing the public-private-partnerships of the future: Learnings from the experiences in pandemic times. *Eurohealth*. 2021;27(1):49–53. URL: https://iris.who.int/bitstream/handle/10665/344956/Eurohealth-27–1–49–53-eng.pdf?sequence=1
10. Casady C.B., Baxter D. Pandemics, public-private partnerships (PPPs), and force majeure | COVID-19 expectations and implications. *Construction Management and Economics.* 2020;38(12):1077–1085. DOI: 10.1080/01446193.2020.1817516

11. van Duijn S., Barsosio H.C., Omollo M., et al. Public-private partnership to rapidly strengthen and scale COVID-19 response in Western Kenya. *Frontiers in Public Health*. 2023;10:837215. DOI: 10.3389/fpubh.2022.837215
12. Baxter D., Casady C.B. Proactive and strategic healthcare public-private partnerships (PPPs) in the coronavirus (COVID-19) epoch. *Sustainability*. 2020;12(12):5097. DOI: 10.3390/su12125097
13. Love P.E.D., Ika L., Matthews J., Fang W. Shared leadership, value and risks in large scale transport projects: Re-calibrating procurement policy for post COVID-19. *Research in Transportation Economics*. 2021;90:100999. DOI: 10.1016/j.retrec.2020.100999
14. Volkova T.V., Rakhlina L.V. Investment activity in Russia amid the COVID-19 pandemic. *Vestnik ekonomicheskoi bezopasnosti = Vestnik of Economic Security*. 2022;(1):250–256. (In Russ.). DOI: 10.24412/2414–3995–2022–1–250–256
15. Munoz-Jofre J., Hinojosa S., Mascle-Allemand A.-L., Temprano J. A selectivity index for public-private partnership projects in the urban water and sanitation sector in Latin America and the Caribbean. *Journal of Environmental Management*. 2023;335:117564. DOI: 10.1016/j.jenvman.2023.117564
16. Wang J., Lin Y. The study of leverage ratio on the operation efficiency of PPP project enterprises in China: Analysis based on DEA-Tobit model. In: Proc. 5th Int. sci. conf. on economics, management, law and education (EMLE 2019). (Krasnodar, October 11–12, 2019). Dordrecht: Atlantis Press; 2019:205–211. (Advances in Economics, Business and Management Research. Vol. 110). DOI: 10.2991/aebmr.k.191225.036
17. Xiong G., Chai Y., Cao Y., Wang X. Influence factors on investment efficiency of the agriculture PPP project based on DEA-Tobit method. In: Xu J., Ahmed S., Cooke F., Duca G., eds. Proc. 13th Int. conf. on management science and engineering management (ICMSEM 2019). Cham: Springer-Verlag; 2019:30–40. (Advances in Intelligent Systems and Computing. Vol. 1001). DOI: 10.1007/978–3–030–21248–3_3
18. Agarwal V., Malhotra S., Dagar V., Pavithra M.R. Coping with public-private partnership issues: A path forward to sustainable agriculture. *Socio-Economic Planning Sciences*. 2023;89:101703. DOI: 10.1016/j.seps.2023.101703
19. Wang Z., Wang X. Research on the impact of green finance on energy efficiency in different regions of China based on the DEA-Tobit model. *Resources Policy*. 2022;77:102695. DOI: 10.1016/j.resourpol.2022.102695
20. Bae B., Seo C. Do public-private partnerships help improve road safety? Finding empirical evidence using panel data models. *Transport Policy*. 2022;126:336–342. DOI: 10.1016/j.tranpol.2022.08.006
21. Yang D., Li L., Notteboom T. Chinese investment in overseas container terminals: The role of investor attributes in achieving a higher port competitiveness. *Transport Policy*. 2022;118:112–122. DOI: 10.1016/j.tranpol.2022.01.024
22. Wanke P.F., Barros C.P. Public-private partnerships and scale efficiency in Brazilian ports: Evidence from two-stage DEA analysis. *Socio-Economic Planning Sciences*. 2015;51:13–22. DOI: 10.1016/j.seps.2015.06.002
23. Gudavalleti P.K., Singh S., Vaidya O.S. Pure output model-based context-dependent DEA: Tool for analyzing Index published by assessing bodies. *Expert Systems with Applications*. 2024;244:122843. DOI: 10.1016/j.eswa.2023.122843
24. Yudina T.N., Balashov A.M. Coronavirus as a catalyst for digitalisation and public-private partnership in medicine. *Mir novoi ekonomiki = The World of New Economy*. 2021;15(1):100–111. (In Russ.). DOI: 10.26794/2220–6469–2021–15–1–100–111
25. Valishvili M.A. The impact of COVID-19 on the implementation of public-private partnership projects. In: Potential for innovative development of the Russian Federation in new geopolitical conditions. Proc. Nat. (All-Russ.). sci.-pract. conf. (Kazan, November 22, 2021). Ufa: Omega Science; 2021:54–57. URL: https://os-russia.com/SBORNIKI/KON-401-NC.pdf (In Russ.).
26. Kuril'chenko I.G., Pantina T.A. The impact of the pandemic on the implementation of public-private partnership projects in Russian water transport. In: Public-private partnership in the field of transport: Models and experience. Proc. 7th Annu. sci. conf. (St. Petersburg, May 28, 2021). St. Petersburg: Institute "Higher School of Management" of St. Petersburg State University; 2021:48–54. (In Russ.).

27. Simen E., Sheresheva M. Yu. PRC government policy regarding Chinese small and medium enterprises in the context of COVID-19 pandemic. *Gosudarstvennoe upravlenie. Elektronnyi vestnik = Public Administration. E-Journal.* 2020;(79):25–50. (In Russ.). DOI: 10.24411/2070–1381–2019–10047
28. Larasati D., Ekawati N., Triyadi S., Muchlis A. F., Wardhani A. Impact of the pandemic COVID-19 on the implementation of construction contracts. *IOP Conference Series: Earth and Environmental Science*. 2021;738:012075. DOI: 10.1088/1755–1315/738/1/012075

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