Fundamentals of a sustainable future: Russian and foreign experience in financing critical infrastructure

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Abstract. Subject/Topic. Scientific article is devoted to the study of Russian and foreign experience of critical infrastructure financing. Methodology. General scientific (observation, comparison, measurement, analysis and synthesis, method of logical reasoning) and special (static analysis, expert estimates, graphic method) methods were used to prepare the research. Results. The following tasks were solved sufficiently to form reasoned conclusions and inferences: the matrix of critical infrastructure objects from the position of their role in providing sustainable development of the national economy was formed. Conclusions/Significance. Russian practice shows steady growth of investments into critical infrastructure objects, which is connected with escalation of external challenges and threats on the international scene and political course of leadership to protect national sovereignty in terms of maintaining critical infrastructure objects in serviceable mode. The main place in financing critical infrastructure was taken by the state budget, financial programs of state banks and funds of national development institutions. Application. The results of scientific research can be applied by industry regulators in the formation of forecasts and scenarios of socio-economic development of Russia, as well as in the development of individual strategies for financing critical infrastructure facilities.

1 Introduction

The importance of ensuring adequate financing of critical infrastructure is determined by its role in ensuring sustainable development of the state as a whole. The modern stage of Russia’s national economic development has never been more dependent on the quality and continuity of infrastructure components of the national economy (transportation, information

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communication, energy chains). The importance of infrastructure projects is also confirmed by the inclusion of indicators of the volume of infrastructure financing and qualitative characteristics of the state of national infrastructure in the list of priority indicators to assess the level of socio-economic development of the national economy. The relevance of the topic of scientific research is due to the importance of forming an effective strategy to accumulate the efforts of the national economy to achieve a qualitative shift in the state of critical infrastructure in Russia and ensure the implementation of its national interests in the international political and economic dialogue of countries. The purpose of this research paper is to study domestic and foreign experience in financing critical infrastructure to ensure sustainable development of Russia. The main hypothesis of the research is the role of critical infrastructure in ensuring national economic security of the country in terms of its sustainable development.

2 Materials and methods

Etymologically, the concept of "infrastructure" means a foundation or foundation, i.e. with regard to the topic of the study, we can say that it is a platform for the superstructure of more highly organized objects and structures. In the domestic literature, theoretical economists (V. Barancheyev, L. Martynov, N. Kuzminykh, A. Trifilova, I. Gurkov, E. Cherednikova, A. Bovin) identify three main approaches to defining the term "infrastructure": structural and functional (emphasis on the functional object of research), systemic (emphasis on the relationship of processes within the research object) and integrated (emphasis on the impact of the research object on the social and economic system). In foreign literature, leading scientists and practitioners in the field of innovation (P. A. Eriksson, L. Fernvall, K. Izsak, E. Griniece, J.J. Mohr, S. Sengupta, S. Slater) apply theories rather than approaches, which is explained by the initiative of innovation development by market institutions: the diffusion theory of innovation, the theory of regional development and the concept of growth poles.

In preparing the scientific study, general scientific (observation, comparison, measurement, analysis and synthesis, method of logical reasoning) and special (static analysis, expert assessments, graphical method) methods were used. The validity and reliability of the results of scientific research is ensured by the correctness and strictness of the construction of logic and research scheme, as well as by the use of official statistical information and analytical data from the verified Internet resources.

Information and analytical support for the research was provided by public reports of InfraOne Research, the state development corporation VEB.RF, topical publications of the rating agency Expert RA, the business portal RBC+, as well as current regulatory legal acts in the field of critical infrastructure financing regulation.

As the digital economy in the Russian Federation develops in accordance with the structural and thematic stages outlined in the Russian Federation National Programme "Digital Economy of the Russian Federation" and the federal project "Digital Public Administration", the emphasis on financing critical infrastructure facilities becomes more and more pronounced. To implement the purpose of this research, let us consider the matrix of critical infrastructure objects from the position of its role in ensuring sustainable development of the national economy (Table 1).

| Table 1. Matrix of critical infrastructure facilities from the perspective of their role in ensuring sustainable development of the national economy. Source: Developed by the author based on [1-5]. |
Critical infrastructure

1. Economic (capable of generating economic revenue or other commercially significant result)
   - transport infrastructure facilities (toll roads, ports, railways),
   - telecommunication facilities (mobile communication towers, satellites, wired communication, Internet-infrastructure),
   - housing and communal complex,
   - life safety (waste management).

   - education and science institutes,
   - public and private financial development institutions (development banks, venture capital funds)
   - infrastructure for innovative development (technology parks, technopolises, single-industry towns),
   - institutions of project management in the area development management

2. Social (infrastructure focused on solution of non-commercial socially important tasks)
   - housing (management of urban environment),
   - health care and life safety (medicine, law enforcement)

   - social security and consumer protection services,
   - environmental protection and monitoring,
   - cultural and sports programmes.

The table above demonstrates the following inference: the financing of infrastructure projects can be divided into two aggregated groups: rigid economic and social critical infrastructure facilities of strategic or priority importance to ensure the stable functioning of the national economy (private partners tend to be concentrated in the economic infrastructure segment) and, accordingly, flexible economic and social critical infrastructure facilities responsible for the actual functioning of the national economy. In international practice, there are both admittedly common and multiple private practices for arranging public infrastructure project financing, which can be explained by different approaches to understanding the functionality of infrastructure facilities and the status of non-state financial institutions that can participate in the financing of such projects (Table 2).

Table 2. The main approaches to organizing financing of critical infrastructure facilities in global practice. Source: Developed by the author based on [2-7].

<table>
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<tr>
<th>Name of approach</th>
<th>Characteristics of the approach</th>
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<td>1. Resource-based</td>
<td>Content characteristic of the approach: infrastructure projects are viewed as monopoly objects of the state, providing it with public policy and management of socio-economic development through the formation of the infrastructure landscape for its subsequent occupation by private commercial structures, a limited range of mandatory social facilities. Financing mechanism: exclusively public sources of financing (state budget, special funds for financing infrastructure facilities) through public investment programmes and project portfolios managed by departmental or sectoral managers of federal and municipal public authorities. Opportunity for participation of non-state financial institutions and private business: Participation of private partners is an exception, and is used only in cases of acute shortage of financing, lack of competent human resources or technology. Scope of the method: Industries closed to civilian turnover (military-industrial complex, aerospace industry, law enforcement structures and armed forces).</td>
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<td>2. Competitive</td>
<td>Content Characteristic of the approach: Infrastructure projects are considered as sources of long-term competitive advantage within the national economy, provided qualified management of them and ensuring technological and quality compliance with international or national standards (e.g. ISO, GOST R ISO/TU, PCT). Financing mechanism: the mechanism of public-private partnership is applied, when at the initiative and in accordance with the requirements of a particular public administration body a concession is formed involving a private partner</td>
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for financing and subsequent operation of infrastructure facilities with a fixed work format (BOT, BLT, BROT, DBFO), in which the public and private partners receive some economically significant result. Possibility of participation of non-state financial institutions and private business: participation of private partners is in most cases a necessary condition for implementation of this approach, which is connected with higher business activity of the private partner, its interest in the financial success of the project and technological superiority.

3. Agent-based approach

Content Characteristic of the approach: infrastructure facilities are considered as a tool to manage the interests of mega businesses and maintain equilibrium in industry markets (by improving infrastructure provision in the industry (mega business acts solely in its business interests), there is an overall improvement in the national economy (all industry participants benefit from the effect). Special mention should be made of the application of this approach in the formation of cross-sector infrastructure cooperation, e.g. in information and communication (e.g. IT mega businesses act as locomotive partners in the development of cross-sector cooperation and interaction even with unrelated industries). Financing mechanism: Typically, a hybrid mechanism is used, which may include both exclusively public financing and selected forms of PPP models, and inter-firm cooperation instruments (e.g. P&S model (Pooling and Sharing, P&S), strategic partnerships, Public and private venture capital funds, and business incubators as well as technology parks and technopolises). Opportunities for participation of non-state financial institutions and private business: The participation of private partners is stipulated individually, but as a rule, private partners initiate infrastructure projects and reforms with state participation. Scope: High-tech sectors of the national economy as well as the digital information and computer technology sector, less frequently cybersecurity and public order monitoring.

3 Results

Based on the above-mentioned specifics of the types of infrastructure facilities and related projects, let us now turn to the analysis of the volume of financing of the public infrastructure projects market for 2015 - 2021 (Table 3).

Table 3. Indicators of Critical Infrastructure Financing in Russia in 2015 – 2021 Source: Developed by the author based on [5, 6, 8].

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<tr>
<td>1. Cumulative financing of critical infrastructure facilities. RUB bn.</td>
<td>3653</td>
<td>4071</td>
<td>4417</td>
<td>4926</td>
<td>4905</td>
<td>5126</td>
<td>5748</td>
</tr>
<tr>
<td>1.1 Economic block facilities</td>
<td>2486</td>
<td>2771</td>
<td>3006</td>
<td>3353</td>
<td>3338</td>
<td>3489</td>
<td>3912</td>
</tr>
<tr>
<td>1.2 Social block facilities</td>
<td>1167</td>
<td>1300</td>
<td>1411</td>
<td>1573</td>
<td>1567</td>
<td>1637</td>
<td>1836</td>
</tr>
<tr>
<td>2. Share of investments in critical infrastructure facilities. as % of GDP</td>
<td>16.7</td>
<td>17.2</td>
<td>17.4</td>
<td>16.9</td>
<td>17.4</td>
<td>18.2</td>
<td>19.4</td>
</tr>
<tr>
<td>3. Government share in the structure of investments in critical infrastructure. %</td>
<td>18.3</td>
<td>16.5</td>
<td>16.3</td>
<td>15.3</td>
<td>14.8</td>
<td>15.3</td>
<td>16.6</td>
</tr>
<tr>
<td>4. Deficit/surplus of critical infrastructure financing. RUB bln.</td>
<td>1420</td>
<td>2178</td>
<td>…</td>
<td>…</td>
<td>3229</td>
<td>&gt;4000</td>
<td>&gt;7000</td>
</tr>
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As can be seen from the above data, there has been a steady increase in investment in critical infrastructure facilities in Russia due to escalating external challenges and threats in the international arena and the leadership’s policy of protecting national sovereignty in terms of maintaining critical infrastructure facilities in serviceable mode: state communications, data transmission and public safety monitoring systems, and increased control over critical road, rail and waterways.

Public investment in critical infrastructure facilities between 2015 and 2021 has been fairly stable in terms of volume - an average of RUB 415 billion to 420 billion per year (not including the best figures for 2018 and 2019), with the highest levels of investment in 2018 and 2019 at RUB 490 billion. However, if we consider the sums of infrastructure investments, growth is evident from a number of megaprojects in the energy sector (Kyzyl-Kuragino TPPK development), as well as railway construction (for example, the Elegest-Kyzyl-Kuragino railway line and Northern Latitudinal Railway development) and regional airport reconstruction, which received over RUB 290 billion from the federal budget.

It should also be noted that in 2019, the Comprehensive Plan for Modernisation and Expansion of Backbone Infrastructure for the Period until 2024 came into effect, which not only defines priority infrastructure projects and facilities, but also sets out the main sources of their funding. To form an objective picture of the long-term financing market for critical infrastructure facilities, the structure of instruments for financing critical infrastructure facilities in Russia for 2015-2021 (Figure 1) was formed.

As can be seen from the graph, the main place in financing critical infrastructure facilities falls on the state budget, infrastructure financial programs of state banks and funds of national development institutions.
development institutions defined by Russian Federation Government Order No. 241-r of 05.02.2021. It should be noted that the market for financing public infrastructure projects follows the path of seamless integration of public and private sectors, and not only through the mechanism of concessions or public-private pa

The experience of critical infrastructure financing in foreign countries will be discussed in more detail below. The geographical instrument of the European Neighborhood and Partnership Instrument (ENPI), which is used to finance cross-border infrastructure projects (mainly roads, railroads), dominates current practice of critical infrastructure financing in the EU, and in such projects, participants are free to use different methods of financing taking into account national legislation or economic situation of the country, i.e., ENPI also acts as a coordination platform and arbitrator.

With the development of integration relations between the EU countries, the institution of sectoral financial funds, which are formed from the contributions of related sectors of different countries (as a rule, the starting point is the strategy of forming cooperative links between enterprises and building transnational business chains, for example in the automotive (Micheline - Mercedes-Benz), pharmaceuticals, energy (Enercon Gmbh. - Wind Europe) sectors is gaining popularity. One example of an all-union sector fund is the White Paper - Transport, which coordinates more than 10 regional and supranational funding funds for transport infrastructure development. Environmental and sustainable development infrastructure projects are strategically placed on the EU agenda, the European Regional Development Fund has been set up specifically for this type of project, accumulating applications from non-profits and civic associations and providing funds on a competitive basis directly to applicants [9].

In the USA, as one of the leaders in the development of innovations of the financial market, in order to ensure stability of financing of public infrastructure projects, the avant-garde for the Russian Federation and even for the EU instruments are applied: infrastructure crowdfunding - implementation of small improvements in social infrastructure and urban space using voluntary donations of citizens themselves (depending on the amount of donation, citizens then receive the property tax deduction for income tax). Currently, the following business models of infrastructural crowdfunding are distinguished:

- charitable crowdfunding is closely related to corporate social responsibility of business and is implemented mainly at the level of large financially wealthy state corporations in the form of donations or implementation of social projects, for example, construction of social facilities, improvement of transport communication, communications,

- Investment crowdfunding is an alternative to closed unit investment funds operating in the Russian Federation and envisages accumulation of multiple small contributions into a common portfolio for subsequent investment of funds in a selected infrastructure project (commercial infrastructure financing is also allowed, for instance, toll roads, sea or river ports, telecommunications),

- Equity crowdfunding - a more highly organized version of the traditional crowdfunding platform in which funds are transferred to an SPV company for the implementation of an infrastructure project. In general terms, it acts as an alternative to project financing for banks and features lower interest rates and higher risk-taking [10 - 14].

A number of countries with long-term strategies focused on renewable and alternative energy infrastructure development (e.g. Iceland, New Zealand, parts of Portugal, Spain and Greece), are actively developing the institute of so-called open-ended bonds, which raise funds from banks and investment funds as well as savings from the public.

Typically, such bonds are aimed at financing energy supply and investors receive preferential rights to use energy from such sources, as well as institutional investors are offered additional benefits from investing capital in the energy infrastructure of the recipient
country (e.g. rights to receive a portion of remuneration from energy sales, commercial replication of infrastructure design experience, technology transfer).

A separate focus should be made on an instrument of financing infrastructure against damage or destruction due to natural disasters or other climatic anomalies - Act-of-Code Bonds (ACBs). Such an instrument is a hybrid of traditional insurance and financial reserves placed in reliable securities (mainly treasury bonds, shares of the world's largest banks, as well as equity participation of international financial institutions - World Bank, EBRD, IMF) [15-17].

Among the most recent cases of CAT bonds is the coronavirus pandemic - with the use of this instrument (more specifically, World Bank pandemic bonds), payments of $195.8 million were made to 64 countries in 2020. The World Bank's Pandemic Coronavirus Bonds were a pandemic bond instrument, with US$195.8 million paid to 64 countries in 2020 (compared to US$320 billion in such bonds).

4 Conclusion

To summaries the results of the research, it should be noted that the problem of finding best practices in organizing the financing of public infrastructure projects is a global one. It should be noted that despite the higher level of development of the financial market and financial institutions in Western Europe and the USA, the role and importance of budgetary sources remains high (on average, budget participation is 15.0 - 25.0%). While studying foreign experience in organizing financing of infrastructure projects, it should be noted that the experience of EU and US countries, as well as the UK, in involving private partners in the implementation of infrastructure projects both from the position of financial donors and managing partners can be adopted. Special attention should be given to the relevant Russian ministries (primarily the Ministry of Economic Development and the Ministry of Health) to developing the institution of so-called CAT bonds to mitigate current and potential losses from pandemic coronavirus and natural disasters and catastrophes.

References