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Determining the country's need for infrastructure investment

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One of the most important issues requiring scientific understanding is the formation of special mechanisms for the development and implementation of infrastructure projects in demand by the main market participants. The purpose of this article is to analyze the determination of the country's need for infrastructure investment.

The assessment of the volume of necessary infrastructure investments, depending on the level of economic development and the degree of development of institutions in a number of countries of the world, based on the use of the following criteria: rapid growth in infrastructure development; large volumes of off-budget infrastructure development (through private companies, PPPs and public sector borrowing); the developing nature of financial markets, the federal nature of the state. An algorithm for determining infrastructure needs has been determined. The need of individual countries for infrastructure investments is calculated, and the influence of the level of development of institutions on the structure of investments is determined.

Key words: infrastructure, investments, needs, development.

In recent years, the Russian economy has entered a protracted phase of structural economic crisis, due to the exhaustion of the potential of the raw material growth model against the background of a sharp decline in prices for oil and other commodities, which are the basis of our country's exports. In 2017, negative factors generally retain their influence, and the subsequent economic development, while maintaining the current institutional environment, is predicted by both independent experts and public authorities in the medium term at the level of 0.9-1.8 percentage points of GDP, which clearly does not correspond to the country's strategic interests.

To change this situation, it is necessary to carry out a number of structural reforms in various areas of the economy and social policy. One of the main tasks of these changes should be to create conditions that ensure the implementation of infrastructure projects that create significant multiplier effects in the economy. Thanks to the successful implementation of such projects, mechanisms for intersectoral development and subsequent economic growth are automatically launched.

The article of P. N. Rosenstein-Rodan [1] and A. Hirshman [2] contributed to the development of institutional issues of infrastructure development, where it was emphasized that the income of the corporate sector depends on the state and level of infrastructure development. In his articles, U. Rostow [3], H. Singer [4] described the existence of a certain relationship between improving the efficiency of the economy and the amount of targeted investment in infrastructure development, described the mechanisms and tools for the development of infrastructure industries. The articles of A. G. Isaev [5], R. M. Nizhegorodtsev [6], and V. G. Varnavsky [7] are devoted to the issues of

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project financing, development of mechanisms for creating and managing infrastructure projects, state infrastructure development programs, and public-private partnerships. Among the scientists who study the problems of infrastructure development, the impact on the rate of economic growth, the efficiency of investment, it should be noted V. B. Kondratiev [8], S. Bougheas, P. Demetriades, T. Mamuneas [9], S. Ledyaev, M. Linden [10], E. A. Kolomak [11], V. G. Varnavsky [12]. Actual problems of development of the infrastructure complex of Russia, including industry aspects, are covered in the works of I. Y. Shvets, Y. Y. Shvets [13], Y.A. Shcherbanin [17]. Questions of development of the infrastructure complex of Russia within the framework of spatial development are covered in the works of p. A. Minakir [15], I. Y. Shvets, Y.Y. Shvets [16, 17], A. N. Tsatsulin [18]. Despite the significant contribution of scientists, increasing international competition requires rethinking the impact of infrastructure on the pace and sustainability of economic growth.

The purpose of this article is to analyze the country's need for infrastructure investment.

One of the most important issues that require scientific understanding is the formation of special mechanisms for the development and implementation of infrastructure projects that are in demand by the main participants of the financial market (institutional investors, development institutions, commercial banks, etc.). the Need for infrastructure development is noted in many scientific studies. Thus, the world Bank concluded that a 10% increase in infrastructure investment leads to an increase in the rate of economic growth in the long term by 1 percentage point. A study by the McKinsey consulting company based on an analysis of empirical data showed that additional infrastructure investment of 1% of GDP created 3.4 million new jobs in India and 1.3 million in Brazil. According to expert calculations, the socio-economic effect of investment in infrastructure is 20%. A number of infrastructure projects are capable of yielding returns in the ratio of 1 to 20.

The annual report on global competitiveness 2017-2018 (the Global Competitiveness Report), published based on the results of a study of the economic condition of 137 countries, and defining national competitiveness as the ability of a country and its institutions to ensure stable economic growth rates that would be sustainable in the medium term, showed that Russia has permanent problems in a number of areas, including infrastructure development. Insufficient investment in infrastructure over the past 10-20 years has relegated Russia to the 103rd place in the world in terms of the quality of public institutions.

An assessment was made of the amount of infrastructure investment required, depending on the level of economic development and the degree of institutional development in a given country. This work was carried out in several areas. As part of the first project, we analyzed a number of countries in the world for which there is current data. In the second direction, countries were selected based on the following criteria: rapid growth in infrastructure development; large amounts of extra-budgetary infrastructure development (through private companies, PPPs and public sector borrowing); the developing nature of financial markets, and the Federal nature of the state.

This approach allowed us to identify groups of countries that have similar development parameters to Russia and have managed to significantly improve the situation in infrastructure development by using certain mechanisms to attract investment. Based on the data obtained, the following sections will identify tools that have improved the state of the infrastructure and should be studied in more detail, and if appropriate adapted for use in Russia.

To carry out this work, using an econometric model, the need for infrastructure investment in individual countries was calculated, and the impact of the level of development of institutions on the structure of investment (public and private; direct and portfolio) was determined. Further, the results of quantitative research were used to determine the list of countries for which it is advisable to conduct a more detailed, qualitative study of infrastructure investment processes.

The approach used to calculate infrastructure investment needs is shown in the enlarged flowchart below (figure 1).

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Determining the country's need for infrastructure investment	Determining the impact of institutions on the intensity of infrastructure investment	By public and private sector _____ In the context of various tools	Determining the feasibility of a qualitative study of infrastructure investment processes in individual countries

Fig. 1 Algorithm for determining infrastructure investment needs

Transport infrastructure, energy and water supply were considered, since the methodology of most sources that study infrastructure investments quantitatively is exactly this. Transport includes motorways (in km) and Railways (in km). Water supply refers to the number of inhabitants of urban or rural areas provided with water supply. Energy is considered in the context of providing residents with access to electricity and per capita electricity consumption (in kWh per year).

The demand for access to electricity and water supply for rural and urban residents was considered based on the obvious need to provide these types of infrastructure to all citizens (100%).

If the physical need of an economy for a particular type of infrastructure cannot be calculated directly (for example, how many kilometers of roads a model country with an area of 100 km2 and a population of 10,000 people needs to build), then the demand for infrastructure was considered a function of the country's population and its area, the parameters of which were determined in the econometric model.

On the basis of developed countries, where demand for these species were accepted as satisfied (Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Italy, Iceland, Japan, Luxembourg, Netherlands, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, UK, USA), was output function of the country's demand for a particular infrastructure type.

Both linear (and multiplicative (regression-based) models were constructed to determine the demand for roads, Railways, and electric power (hereinafter referred to as the population in people, the country's area in km2). In all cases, the multiplicative models were characterized by higher quality, so they were chosen for further calculations.

Demand functions:

For Railways (in km):, based on the regression equation:

On highways (in km): , based on the regression equation:

For electrical power (in kW): , based on the regression equation:

Then these functions were substituted for the real values of the area and population of developing countries. The difference between the received model value and the actual value was interpreted as an unsatisfied demand for infrastructure.

The demand for infrastructure investment was determined based on the prices of certain infrastructure elements multiplied by the demand for these types of infrastructure in real terms, calculated by researchers close to the world Bank in the study Infrastructure Investment Demands in Emerging Markets and Developing Countries[19].

The demand for roads in the section of paved and unpaved roads was determined based on the target level of paved roads in 40% of the total number of roads.

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Thus, we obtained the values of potential demand for infrastructure for a number of countries in both physical and monetary terms, as well as in % of GDP. The demand for infrastructure in this study is defined as the amount of investment that allows you to bring a particular economy to the level of a developed country in terms of the availability of these types of infrastructure. You can see that in Russia it is 42.22% of GDP, which is quite average (for comparison: Australia – 6.92%, Malaysia-28.95%, Turkey-32.88%, Mexico-43.36%, Brazil-48.88%, Nigeria-134.05%, India-146.74%).

In the context of certain types of infrastructure, it can be observed that Russia's real demand for infrastructure will not be fully met after the implementation of long-term development strategies. Thus, the implementation of the Transport strategy for the period up to 2030 in relation to roads and Railways will only bring us a third closer to the target value for a developed country.

Indicators were calculated that characterize the period of satisfaction of the current need for infrastructure investment: the demand for infrastructure investment as a percentage of GDP was divided by the share of infrastructure investment in GDP (T=D/I).

Models were built to track the relationship between this period in different countries and indicators that quantify the level of development of certain institutions. Data from the Heritage Foundation, World government Indicators (WGI), Global Competitiveness Report, and BMI Research Group were used for this purpose.

By consistently excluding the least significant factors, it was found that differences in the timing of meeting current investment demand are best explained by differences in the rule of law indicator: Rule of Law, calculated in the WGI database, which includes the protection of private property rights, the degree of development and independence of arbitration courts, as well as the overall crime rate. The following models were constructed based on regression equations:

Time to meet current demand through all types of infrastructure investments:

Term for meeting current demand through public investment:

Using these models, it is possible to extrapolate the results obtained to countries where quantitative estimates of the development of institutions are known, obtaining long-term equilibrium rates of infrastructure investment in the context of private and public as a percentage of GDP. The "equilibrium rate of infrastructure investment" refers to the amount of capital investment in infrastructure projects that can be productively assimilated by the economy at a given level of development of institutions (i.e., it can be not only invested, "mastered", but also translated into real assets that contribute to meeting the demand for infrastructure and economic growth, respectively). The model was tested in a country not included in the original sample, India. The model predicts a long-term equilibrium rate of infrastructure investment of 7.3% of GDP, which coincides with the real value (Annex 3, table 3.6).

The long-term equilibrium rate of infrastructure investment in Russia was defined as 1.17% of GDP (of which 0.80% of GDP is public investment and 0.37% of GDP is private). At first glance, this does not agree with the long-term forecast proposed in the Gazprombank review (estimating this figure at 2.6% in 2016 and 2.3% in 2020 [20]).

However, the same forecast shows how dramatically different the forecasts of infrastructure investment based on the calculations of the Federal target program and Gazprombank on the example of the port industry - by 2020, the estimates of Gazprombank are almost 3 times lower than the estimates of the Federal target program. Finally, there is an assumption that a significant part of infrastructure investment in the Russian economy is currently not being used effectively – this is indicated by the negative growth rates of building developments in Russia (an indicator used by BMI Research Group to analyze the dynamics of infrastructure development) in 2016 and 2017. Thus, it is possible to form a statement that the pessimistic forecast is justified and that the majority of forecasts

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underestimate the institutional problems of the Russian economy. Such striking deviations of the model values of the level of infrastructure investment from the forecasts may also indicate the need to further Refine the model and include some factors that take into account the Russian specifics. However, the suboptimality and insufficiency of the equilibrium 1.17% of GDP infrastructure investment that the model predicts is obvious, which indicates the need for institutional changes.

The proposed model also allows us to assess the target level of development of institutions to achieve a particular amount of infrastructure investment. Thus, to reach the forecast value of 2.6%, it is necessary to significantly improve the investment climate in Russia in terms of property rights, arbitration and crime ("Rule of law", according to the WGI methodology, must be increased to a value of 0.20, which is comparable to Croatia, Saudi Arabia or South Africa). To achieve the goal of 4% of GDP, the Rule of law indicator should be 0.72-the level of Latvia, Lithuania, Poland and Macao.

We also built an econometric model of the interdependence of private and public infrastructure investments (in % of GDP). Theoretically, it can be observed how the displacement (crowding out effect) private investment public (through the implementation of government projects, which is so attractive for private investors and entrepreneurs and due to the effect of rising interest rates as a result of increasing budget expenses) and synergistic effect (the implementation of large-scale infrastructure projects the public sector has significant positive externalities, provides a multiplier effect and reduce costs, making the smaller private projects profitable and attractive investment). Thus, the nature of this relationship and the factors that determine it must be determined empirically.

Initially, it was assumed that the model should look like this:

That is, private investment in infrastructure depends on both some underlying demand for infrastructure and a set of institutions, and on public investment, with the extent and closeness of the latter relationship (the predominance of crowding or synergy) depending on another set of institutions.

By consistently excluding the least significant factors, it was determined that the first set of institutions is related to property rights (in the narrower definition of Heritage Foundation), and the second set is related to the openness and development of financial markets (an indicator calculated in the Global Competitiveness Report). As a result, the model took the following form:

Thus, for productive interaction between the private and public sectors in infrastructure industries, we need developed institutions that guarantee the rights of investors in both the real and financial sectors. For Russia, the displacement coefficient is -0.19 (for comparison: Argentina – -0.46; Brazil – -0.09; Chile-0.04; Panama-0.10). This means that on average, 5 rubles of public infrastructure investment in Russia displaces 1 ruble of private investment. To eliminate this effect, it is necessary to increase the coefficient of development of financial markets from 3.53 to 4.45, to the level of Bahrain and Belgium (i.e. to rise from the 95th place in the world by this indicator to 32).

To determine the structure of infrastructure investments in relation to direct and portfolio investments, the direct account method was used: private infrastructure investments were subtracted from private infrastructure investments (world Bank data for the three sectors under consideration-transport, energy and water supply), this method was used to calculate private portfolio infrastructure investments. The structure of portfolios of infrastructure institutional investors in the context of government bonds, corporate bonds and loans in the most developed Latin American countries is calculated by BBVA Research.

Then we built simple one-factor models that can evaluate the structure of portfolio infrastructure investments in a particular country (the share of government bonds and the share of corporate bonds). The share of government bonds was in a strong feedback with the ease of access to loans Institute (a

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measure considered in the Global Competitiveness Report), and the share of corporate bonds is growing along with the share of portfolio infrastructure investments in GDP.

According to OECD data, $ 2.6 trillion of debt infrastructure securities and $ 0.9 trillion of equity securities are currently traded on the global financial market. Accordingly, the share of debt securities in portfolio infrastructure investments is 74% on average worldwide. For Latin American countries, this value is much closer to 50%, and the estimates obtained for Russia indicate the rationality of equity investment in infrastructure. It can be assumed that this is due to the fundamental differences in the nature of infrastructure projects that are implemented in countries with different levels of overall economic development and institutional environment.

On the basis of the constructed models and quantitative research generated the conclusion about the necessity of a more thorough qualitative review of the characteristics of infrastructure investment in developing countries from the above list or in the developed countries, characterized by a high level of institutional quality affecting the efficiency of infrastructure investments (England, France, USA, etc.). The disadvantage of the proposed approach is that it allows to evaluate investments in so-called "green field" projects. At the same time, the lack of open access methodologies for calculating investment needs of the world Bank, McKinsey, and Gazprombank does not allow us to answer the question of their accounting for investments in "brown field"projects. To eliminate this shortcoming, the econometric model was supplemented with an indicator of the cost of fixed assets and the volume of GDP. According to McKinsey, the market value of infrastructure assets should be about 70% of GDP (in Russia-60%). This amount of investment in infrastructure (at a certain level of institutional development) allows for positive GDP growth rates. If this indicator is exceeded in the long term, the economy will not find resources within its system to update infrastructure, and this will lead to a decrease in its growth rate. In accordance with this, the value of infrastructure assets at 70% of GDP was determined as a benchmark. This indicator reflects to a certain extent the volume of "brown field" projects. The achievement of this indicator may indicate the solution of infrastructure development tasks. The difference between the actual value of infrastructure assets and the reference value (taking into account the forecast of the desired growth rate of economic development) will reflect the required amount of investment. Given that the built infrastructure sooner or later needs to be updated (the average period of 15 years), taking into account the average renewal period and the cost of infrastructure assets, it is possible to estimate the amount of necessary investment based on the average volume of replaced investments (no more than 40%). It is important to note that the estimates obtained showed a dependence on the previous estimates for green field projects, and the sample of countries for further analysis is fair.

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