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Optimization of Participation Financing of Investment Programs with the State Support

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Abstract: In the study are considered questions of mathematical modeling and algorithmization of the economic programs investment. We offer a system of indicators of efficiency of investment projects from the point of view of federal and regional importance and assessment of their feasibility. Investors are grouped in clusters depending on their attitude towards investments put into the project: own, borrowed commercial or state funds. We construct algorithms for investment decision-making by various groups of investors and the general algorithm of investment of the economic program.

Key words: State financing, decision-making, investment program, cluster, Russia

INTRODUCTION

Optimization of the structure of financial resources for the investment programs is one of the most important decision-making tasks in the process of economic development of regions and countries. Optimization belongs to formation of a set of investment tools, including federal support that allows to make national economy attractive to private investors.

The problem of optimization of private and state investments is a field of interest of numerous researchers. Piketty (2007) and Piketty and Ganser (2014) carries out the comprehensive analysis of dynamics of investments and their influence on various aspects of well-being of nation in historical prospect. Bernanke (1983) and Perez (2002) pay the main attention to interrelation of investment processes and long-term business cycles (Bernanke, 1983; Perez, 2002). Influence of uncertainty on decision-making is investigated by Bloom (2009) Kose and Terrones (2012) and Dixit and Pindyck (1994). In particular, Bloom investigates changes of level of economic uncertainty at different stages of a business cycle and considers influence of these fluctuations on behavior of economic agents (Bloom, 2009).

Investment of programs of economic development comes from many sources, both private and state and each of the parties has to consider interests of all participants. The main criterion of private investors is profitability of the project whereas for the state the most important are criteria of providing a sustainable development of industries and regions. Because of the unequal dynamics of prices for products and service, necessary for implementation of investment projects, increase in investments renders different effects on various sectors of economy (Vedev, 2014). Relevance of the research topic is also caused by the importance of credit resources for a number of industries in Russia with high risks of crediting.

For the reflection of criteria of private and state investors and also their estimates of risk in the study, we propose the model of decision-making process of economic agents-investors of various types.

Instruments of the state financing of economic development programs in Russia and abroad: The comparative analysis of systems of support of economic development programs in different countries shows that, despite economic and structural distinctions, it is possible to track the general directions in which the countries move to their purposes. The scheme of distribution of the most popular instruments of the state support of development programs in foreign countries is submitted in Fig. 1. Undoubtedly, the most general property of the state support instruments of economic development is their focus on innovations.This conclusion can be drawn on the basis special attention to scientific researches, special conditions of granting and tax benefits to venture companies (OECD, 2012). The integral line of tools of state support in Europe is their systemacity that is shown in creation of clusters and development of the companies created in common by research institutes and business (OECD, 2012) and also their special focus on the industry, the contribution to which makes up to 75% of total amount of the state investments in Germany, Sweden and Finland.

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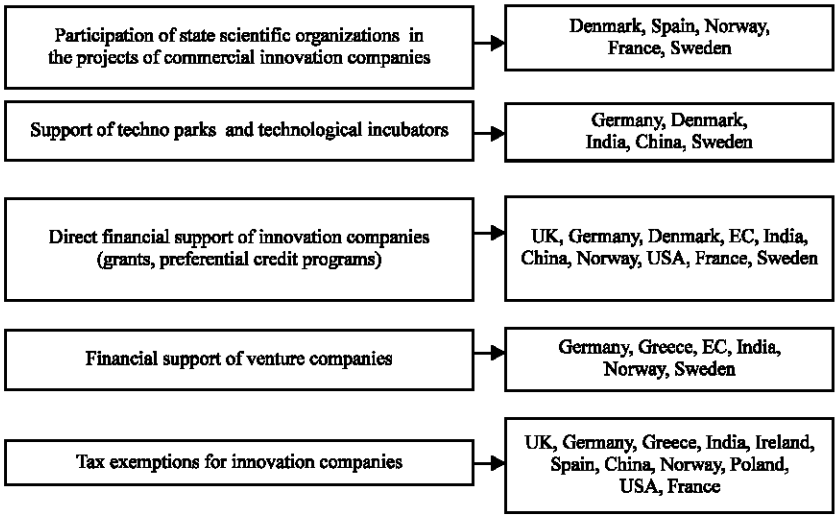

Fig. 1: Instruments of state support of investment programs in different countries

The specified ways of the state support of economic programs are not fully used in the policy of Russian Federation, some of them are still considered by the Government. We can divide financial and economic instruments of state support of economic development used in Russia at federal and regional levels into several groups:

- Participation financing from the budget; federal and regional funds (under the lowered credit percent)
- Granting the state guarantees on the credits of commercial banks or other investors
- Tax regulation and special depreciation charges
- Customs regulation
- Subsidies and grants within the programs of participation and grant financing

Means of investment funds and organizations, including venture companies are one of the main instruments of innovative development financing in many countries. Characterizing state support of investment programs in Russia, it is possible to note that now funds with state participation are being created.

Funds are differentiated by priority directions of financing, including such characteristics of investment projects as their belonging to a certain industry, expected import substitution and reliability of financial assets of the project's initiator.

In 2005 Investment fund of Russian Federation was founded. This fund represents a part of the federal budget that should be used for implementation of investment projects of nation-wide and regional value on the principles of public-private partnership (Investment Projects of Russian Regions Website). The analysis of the state register of the regional investment projects which have received subsidies from Investment fund of Russian Federation has shown that the main direction of granting is social and economic development of subjects of Russian Federation in particular creation and development of transport and power infrastructure objects of state ownership, housing and communal services. In general the projects realized with assistance of the Investment fund have exerted positive impact on the budget receipts. It is expected that additional payments to the federal budget in connection with projects implementation will exceed 250 billion rubles till 2020. It would mean that 1 rub. of the funds of the federal budget allocated for participation financing generates 2,78 rub. of receipts in regional and local budgets. Except Investment fund of Russian Federation, there are also Russian Scientific Fund (RSF), Russian Fund of Basic Researches (RFBR), Russian Humanitarian Scientific Fund (RHSF), fund of assistance to development of small forms of the enterprises in the scientific and technical sphere (Bortnik's Fund) (Investment Projects of Russian Regions Website).

The analysis shows that now plurality of the existing financing sources became distinctive feature of the organization of financing of economic development programs, however, the level of development of infrastructure of financing is defined not only the number of the created institutes of support but also efficiency of their work, namely: stability, availability and financial return from implementation of innovative projects. Therefore in this research the main attention will be paid to target financing of investment programs.

MATERIALS AND METHODS

Mathematical model: In this research, we make a mathematical formalization of investments distribution between the projects chosen by experts for the state support. This process has to provide a compromise of interests of the initiator of the project and the attracted investors. Interest of the investor is in receiving the greatest possible return from investment of capital in the project, at the same time financial return is the most significant for commercial investors and social criteria gain the greatest importance for state investors. The initiator of the project seeks to cover the need for financial resources by the cheapest financial resources so that implementation of the project would remain profitable for him (Mashkova, 2014). The compromise of two groups of economic agents is reached by including the state in the investment process. The state is able to support the projects financially and it also has instruments of indirect financing, applying which the state controls the structure of the raised funds.

The optimal structure of investment of the program represents such a distribution of financing among investors which allows to minimize a total cost of fund raising due to the state support. It is possible under a condition of satisfaction of investor's interests which means achievement of a certain efficiency level. Thus, the main criteria of optimality are the minimum cost of the raised funds for the initiators of the projects and the ratio between profitability and risk for investors.

The model is designed for making the optimal distribution of investor's funds taking into account need for financing of the investment program with the state support (further the Program). It is reached by stage-by-stage algorithm of actions that relies on the behavior principles of participants of investment process. Possible investors of the Program are divided into clusters depending on the cost (S_k) of attraction their funds to the project. At the same time we consider that S_k represents the minimum cost of the investment tool from available in each cluster. Considering different financing terms, we determine four cluster groups of investment funds.

Group of investments K_1 is made from own funds of the initiator of the project. Investments of the first group are characterized by the smallest cost of raising but also the maximum limitation. We will accept the cost of own funds equals one.

Group of investments K_2 is state funds, including federal, regional and municipal level of the financial system and state investment funds. State funds are distributed to investment projects through various target programs of state support, programs of participation and grant financing. The cost of attraction of state funds for the initiator is equated to the cost of K_1 funds if participation of the state in the investment program is carried out on the terms of participation financing, interest-free and non-repayable. In case state funds are raised on other conditions, the state can be considered as the investor of the following cluster group.

Group of investments K_3 is non-state investment funds. Normally, investment funds are ready to provide financial resources on conditions, more favorable to the initiator, than banks or private investors. These are the specialized financial and credit institutes having their own financing conditions, therefore they are determined in a separate cluster which has a priority for innovation projects in comparison with cluster group K_4. Investment funds are usually limited to their specialization.

In the group of investments K_4 we include funds of private investors, foreign investors and credit institutions. Funds of this group of investors are not limited but they are the most expensive" to the initiator of the project and are attracted in the last turn if funds of K_{1-3} clusters do not fill the financial requirement of the project. The cost of K_4 funds is equal to one plus the interest rate.

Algorithms: The algorithm of optimization of participation financing of the Program is presented in Fig. 2. Here will consider the main stages of process of decision-making by investors.

Formalization of characteristics of alternative investment projects. Within the offered model of decision-making it is supposed that each project P_i is characterized by the following five private indicators of efficiency:

- Commercial efficiency of the project N_1
- Budgetary efficiency of the project N_2
- Social efficiency of the project N_3
- Regional importance of the project N_4
- Federal importance of the project N_5

It is obvious that the importance of each efficiency indicator is not identical to each investor, however each type of efficiency anyway influences integrated efficiency of the project for each cluster of investors. As a result we build the matrix containing values of indicators of efficiency of each project.

Determination of the importance (z_{kg}) of each efficiency indicator (p_{gi}) for each investor. In the offered model risks are considered in the general assessment of feasibility $r_i (i = \overline{1, n})$ of each project $P_i (i = \overline{1, n})$. In order to make mathematical model similar to real economic conditions indicators of integrated efficiency of a project

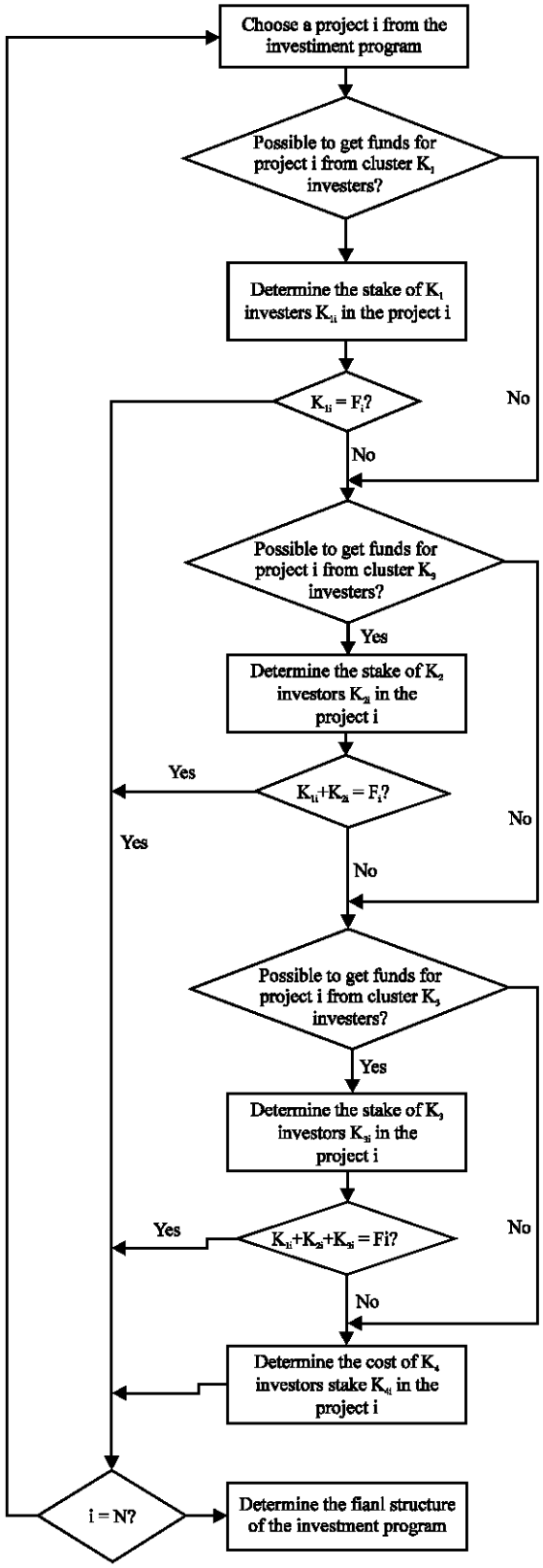

Fig. 1: Algorithm for defining optimal structure of the investment program financing

i are corrected by taking into account estimated feasibility of the project. The assessment corrected with risk factors of the project allows to make a rating of projects on the basis of the "efficiency-risk" ratio. We build a total matrix of integrated estimates of the project's efficiency for each cluster of investors (e_{ki}) by multiplying the matrixes:

$$\left\{ e_{ki} = \sum_{g=1}^{5} z_{kg} \times p_{gi}, \sum_{g=1}^{5} z_{kg} = 1 \right\}$$

Distribution of funds depends on the expected integrated efficiency of the project which has to exceed a threshold for each investor. If this condition is satisfied the investor makes a positive investment decision.

Definition of the general need for investment of all projects of the Program on the basis of the business plans $\sum_{i=1}^{n} F_i$ where F_i required financing for project $P_i (i = \overline{1, n})$. Attracting investors and determining sum of their funds $\sum_{k=1}^{m} \Phi_k$ which they are ready to invest in the Program where Φ_k funds of the cluster k investor $(k = \overline{1, m})$.

In real economic conditions the investor's decision is influenced by risk that the investor would not gain the promised effect or would receive it with violation of repayment term. We assume that risks of the projects are presented in appropriate sections of business plans. Risks are included into the model through indicators of feasibility $r_i (i = \overline{1, n})$ of each project $P_i (i = \overline{1, n})$. Indicators of integrated efficiency of the project i are corrected with the esteem of feasibility $r_i (i = \overline{1, n})$:

$$O_{ki} = e_{ki} \times r_i$$

Where:

e_{ki} = Esteem of efficiency of the project P_i for cluster k investors

r_i = Esteem of feasibility of the project P_i

Determination of cost of cluster k investor's funds based on esteem r_i of feasibility of the project i and interest rate R_k:

$$S_{ik} = R_k((1-r_i)+1)$$

Calculation of the discounted price of raising funds for the project P_i:

$$Q_i = \frac{\sum_{k=1}^{4} F_i \times y_{ik} \times S_{ik} \times T_i}{(1+E)^{T_i}}$$

Where:

Q_i = Discounted price of raising funds for the project P_i

$F_i (i = \overline{1, n})$ = Funds required for the project P_i

y_{ik} = Part of cluster k investors k the project P_i

S_{ik} = Cost of raising funds of cluster k investors $K_{\overline{1,4}}$ to the project P_i
E = Discount rate
T_i = Realization term of the project P_i

Formalization of the optimization function. As a criterion of optimality we will accept minimization of a total cost of raising funds of investors:

$$\sum_{i=1}^{n} Q \to \min$$

Where:

$$\begin{cases} Q_i = \dfrac{\sum_{i}^{j} F_i \times y_{ik} \times S_{ik} \times T_i}{(1+E)^{T_i}} \\ \sum_{k=1}^{m} F_i \times y_{ik} = F_i, \\ \sum_{i=1}^{n} F_i \times y_{kj} = \Phi k, \\ \sum_{k}^{m} y_{ik} = 1, \\ \Phi_k \le \Phi_{max}, \\ i = \overline{1, n};\ k = \overline{1, m} \end{cases}$$

The algorithm is based on the following decision making principles of investors

- Decision making principles of cluster K_1 investors.
- Own funds and cluster K_2 investor's funds are raised at maximum
- If sum of own funds and cluster K_2 investor's funds is enough for the project, following steps for the project P_i are unnecessary
- Otherwise the initiator tries to get cluster K_3 investor's funds
- If cluster K_3 investors are not interested in the project P_i or their subsidy is not enough, the initiator gets cluster K_4 investor's funds
- Decision making principles of cluster K_2 investors
- If the project P_i is characterized by considerable public efficiency, federal or regional importance but integrated efficiency for investors of other clusters does not exceed threshold, then the project P_i is financed completely from cluster K_2 investor's funds
- While funds are not exhausted, other projects are financed on the basis of a rating of their integrated efficiency for this group of investors on the terms of participation financing (the requirement becomes covered at maximum 50%)
- If funds of cluster K_2 investors are exhausted, then cluster K_3 investor's funds are raised
- Decision making principles of cluster K_3 investors
- While funds are not exhausted, the projects are financed on the basis of a rating for this group of investors on the terms of participation financing (the requirement becomes covered at maximum 20%)
- Decision making principles of cluster K_4 investors
- Investors of this cluster are able to finance all projects if they are given guarantees or other instruments of the state support, cost of the raised funds depends on criterion of feasibility of the project

CONCLUSION

Optimization of private and state investments provides economic development to certain industries and national economy as a whole. When an investment program needs participation financing both the initiator and potential investors are in search for a tool for estimating efficiency of fund raising. The developed model takes into consideration subjective components of decision making by investors by dividing them into clusters on the basis of their behavioral principles. We include into the integrated indicator of the project's efficiency the estimate of its feasibility which makes mathematical model similar to real economic conditions and provides an opportunity of rating projects by risk and efficiency. Due to the fact that the investor's economic interest is taken into consideration, they can become more active in participation investment of innovative projects. The offered approach improves the prospects of state-private partnership and involves a wide range of investors in the investment process.

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