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Method of Selection of Options for Public Housing Assistance Program Based on Public-Private Partnership

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ABSTRACT

A method for the choices of government support of housing programs based on public-private partnership, which is based on an economic-mathematical theoretical model that adequately reflects the relationship and the relationship of subjects of housing programs, socio-economic factors, budgetary constraints, parameters, lending instruments of budget support . The proposed method is tested on the materials of the Russian Federation, has enabled the evaluation of the effectiveness of possible incentive options participants of housing programs.

JEL: C51, C52, E27, E62, H53, R38, Y10.

Keywords: Method, model. optimization, government support, the program partnership.

1. INTRODUCTION

The analysis of the state of the housing problem of the Russian Federation showed that at the present stage in ill apartments inhabited by more than 40 million. persons, in an emergency or dilapidated housing - 6m. persons, in line to improve housing conditions registered 4.43 million. persons, and the average waiting time was 19.3 years. Furthermore, the average population of living space in Russia in 2016 amounted to 22.4 square meters. per person, which is 2 times lower than the average in the European Union. In this year in Russia built 0.25 square m. of housing per person, although based on needs housing construction should be 1.3 square m.

Analysis of the dynamics of the implementation of targeted housing programs and the evolution of the government's housing policy has shown inconsistency and low efficiency of both public and market-based approaches to solving the housing problem. One of the urgent problems in the housing sector is still the financial support of housing programs and the need to attract private investment in housing, which can be partially solved by the use of borrowed funds raised through mortgage lending instruments.

The solution of this problem requires the discovery, development and implementation of new approaches and methods of financing the housing sector through public-private partnership (PPP), the further development of appropriate forms, methods and mechanisms of interaction between participants of housing programs that allow efficient use of both public and private financial resources as well as the formation of a holistic concept.

According to Raizberg B.A. (2002) program is a set of goal-oriented, planned to conduct systematic, coherent content and coordinated in space and time measures aimed at solving certain problems.

Taking into account and respecting the position shown above, in an article housing program means a series of linked resource, timeframes and relevant socio-economic, scientific research, industrial, organizational, economic and other measures to ensure the effective solution of priority tasks of the state housing policy requiring state support and implemented in a specific territory. Housing programs include housing projects, under which the work is understood as a focused time-limited set of activities aimed at solving the housing problem.

Features of interaction and relationships of participants in the ongoing housing programs in the Russian Federation determine the need to review the effectiveness of housing programs not only at the micro, but also at the macro level, as a function of a wide range of factors, which necessitates the development of economic and mathematical models to implement evidence-based selection and evaluation of management decisions within the framework of the government's housing policy.

Methods for the quantitative estimation of the impact of government decisions on economic processes at both the macro and micro level are being developed in the works of V.A. Averchenko (2006) A.A. Ashimov (2004), S.M. Valitov (2011), V.P. Oreshin (2008), G.G. Fetisov (2010). In modern economics the main task in this direction can be defined as the development of methodological tools and models to assess the efficiency of existing programs in order to create a basis for making informed and effective management decisions.

Modeling and performance evaluation of ongoing housing programs whose primary purpose is to achieve maximum satisfaction of the housing problem is an important theoretical and methodological challenge that should solve modern economic science. Study of publications devoted to this subject has shown that in domestic science and practice, there is no single methodological approach to solving this problem in the housing sector, which leads to the urgency of further research in this area.

In our opinion, the rationale and implementation of economic-mathematical model of optimization of state support for housing programs on the basis of PPP includes the following series of successive interrelated stages.

The first stage. Statement of the problem involves the production objectives of the study, which is to develop a model to optimize the structure of state support for housing programs on the basis of PPP in order to maximize the growth of housing citizens with limited budgetary resources.

The second step is to select a model as a result of the study. At this stage, the formalization of the situation in the housing sector, the banking sector and public finances, assessment of actors and factors, the construction of mathematical relationships in the form of equations.

In the third stage of the modeling process is under development and justification of the list of variables and constraints.

The fourth stage is aimed at the formulation of the objective function of maximizing growth in housing provision through government support of housing programs on the basis of PPP. In the fifth stage of the proposed model analyzes the optimal solution of the formulated mathematical problem.

The sixth stage of the simulation is to inform management decisions within the framework of the government's housing policy, allowing to achieve maximum effect, solving the most important socio-economic problems of shelter.

In order to increase the validity of management decisions within the framework of the government's housing policy formulated by the author and the proposed methodological approach for the selection of variants of government involvement in housing programs on the basis of PPP, based on the developed economic and mathematical model reflecting the relationship of parameters of mortgage lending, budget constraints, participants, and volumes options for state financial support housing programs.

Under the terms of the model is provided for i periods of exercise m mortgage projects. The volume of new housing in i-th period on j-th mortgage housing project will be equal x_{ij}.

Each project may provide a growth in the number of citizens, to improve living conditions

$$P_{ij} = \frac{x_{ij}}{k\beta}$$

The k- the social norm of housing for 1 person, square m., and β - the average size of family, persons. Public expenditure on the implementation of the j-th project are a_j, the total (general) costs do not exceed the allocated annually for this purpose budgetary funds V_{gi}. Moreover, projects the 1st, 2nd and 3rd, *e.g.,* overlap each other in the sense that it is known: from the three draft can not all be fulfilled.

Then the total socio-economic impact of the implementation of the mortgage housing projects will be expressed in the form of the objective function

$$F(x) = \frac{1}{k\beta}\sum_{i=1}^{n}\sum_{j=1}^{m} x_{ij} \times z_{ij} \to \max$$

At the same time, the financial resources to be allocated for new mortgages projects (which are decided in the planning period), limited the total amount of public funds allocated to the housing problem, reduced by the amount of payments on the previous mortgage housing projects V_{ij}.

As a result of the restriction on the allocated funds is given $\sum_{i=1}^{n}\sum_{j=1}^{m} a_{ij} \times z_{ij} \le \sum_{i=1}^{n} V_{gi} - \sum_{i-1}^{n}\sum_{j=1}^{m} V_{ij}$.

The requirement for the realization of one of the mortgage is recorded as projects

$$\sum_{j=1}^{m} z_j = 1$$

The mathematical problem is written as follows: it is necessary to estimate the values of variables in which the objective function F(*x*) is to make optimal decisions. As a global optimization criteria is considered a maximum number of families to improve their living conditions. A given optimality criterion allows you to select from a common set of mortgage housing projects submitted for funding in terms of socio-economic benefits.

In general, the problem of optimization of state support for housing projects on the basis of PPP can be represented by the following system of equations:

$$F(x) = \frac{1}{k\beta}\sum_{i=1}^{n}\sum_{j=1}^{m} x_{ij} \times z_{ij} \to \max, \text{ при} \quad (1)$$

$$\begin{cases} \sum_{i=1}^{n}\sum_{j=1}^{m} a_{ij} \times z_{ij} \le \sum_{i=1}^{n} V_{gi} - \sum_{i=1}^{n}\sum_{j=1}^{m} V_{ij}, \\ \sum_{i=1}^{n}\sum_{j=1}^{m} a_{ij} \ge 0, \ \sum_{i=1}^{n} V_{gi} \ge 0, \ \sum_{i=1}^{n}\sum_{j=1}^{m} V_{ij} \le V_{gi}, \\ z_j = \begin{cases} 1 \\ 0 \end{cases}, \ \sum_{j=1}^{\hat{o}} z_j = 1, \ j = \overline{1,m}, \ i = \overline{1,n}. \end{cases}$$

Где
- k – Social norm of housing for 1 person, square. *m*.;
- β – The average family size, pers.;
- x_{ij} – the volume of new housing in -th period on -th mortgage housing project, square. *m*.;
- a_{ij} – Public expenditure on the implementation of the -th project in -th period, *bln*. rub.;
- z_{ij} – Boolean variable, 1 if the -th project is implemented, 0 - otherwise;
- V_{gi} – Public expenditure on provision of housing finance in -th period *bln*. rub.;
- V_{ij} – Public expenditure attributable to -th period on previously adopted and implemented *j* - th mortgage housing projects, bln. rub.;
- m – The total number of projects,
- n – The number of periods, $j = \overline{1,m}$
- F(*x*) – The objective function; $i = \overline{1,n}$
- W – The set of solutions.

The presented model allows to obtain reliable estimates of the impact of housing programs, to forecast the outcomes of different variants of the government's housing policy, as well as evidence-based selection of optimal variants of state financial support to participants in housing programs.

In the developed model as an optimization criterion used one of the indicators of socio-economic effects - the maximum increase in the number of families to improve their living conditions. Thus, the solution of a mathematical problem is to find such an option state support for housing mortgage programs with limited budgetary resources, which would provide the maximum social and economic effect.

The growth of housing provision (ΔO_{ij}) in the *i*-th period as a result of *j*-th mortgage housing project can be determined using the following formula:

$$\Delta O_{ij} = \frac{\sum_{i=1}^{n}\sum_{j=1}^{m} P_{ij} \times V_{hi}}{V_p} = \frac{\sum_{i=1}^{n}\sum_{j=1}^{m} (\Delta(S_{gij} + M_{bij}) \times V_{hi}}{V_p}$$

Где S_{gij} – The number of people improve their living conditions by the state in *i*-th period on on *j*-th mortgage housing projects;

M_{bij} – The number of new potential borrowers in *i*-th period on *j*-th mortgage housing projects;

V_{hi} – The average size of the purchased property in *i*-th period, square *m* .;

V_p – The population of the Russian Federation, pers.

When this option for budget support subsidizing the initial payment for mortgages:

$$S_{gi} = \frac{V_{gi} - V_{pi}}{G_{si}}$$

and $$M_{bi} = \frac{V_{pi}}{DP_i}$$

V_{pi} – Budgetary funds allocated to subsidize the initial payment for mortgages in *i*-th period, *bln.* rub.;

V_{gi} – Annual government spending on solving the housing problem in *i*-th period *bln.* rub .;

G_{si} – Government spending per 1 person. on social programs in *i*-th period, ths. rub .;

DP_i – The average size of the initial installment in *i*-th period, ths. rub.

For the option of state support to subsidize interest rates for mortgages:

$$S_{gi} = \frac{V_{gi} - V_{ri}}{G_{si}}$$

and $$M_{bi} = \frac{V_{ri}}{V_{bi} \times G_{rbi}}$$

Где M_{bi} – The number of potential mortgage borrowers in the *i*-th period;

G_{rbi} – Spending budget to subsidize interest rates on the average residential mortgage loans in *i*-th period, ths. rub.;

V_{ri} – Budgetary funds allocated to subsidize interest rates for mortgages in *i*-th period, *bln.* rub.

The economic-mathematical model to evaluate the effectiveness of the various options offered by the state financial support to the implementation of the mortgage on the basis of PPP projects, is flexible, adaptive, and unlike existing provides the ability to optimize the financing structure of mortgage housing projects in order to maximize the socio-economic impact that increase the efficiency of solving the most important socio-economic problems of shelter.

The proposed algorithm choices of state support for mortgage housing projects on the principles of PPP may be aggregated to present the following steps:

1. Assessing the impact of selected parameters of state housing policy on the effectiveness of housing programs through the identification of appropriate sensitivity functions based on system simulation;
2. Choice of parameters of budgetary support housing projects in the framework of the government's housing policy based on the solution of the corresponding extremal problems in the system simulation.

To assess the sensitivity of the parameters of the economic-mathematical model and illustrate the solution of the problem using the geometric method. Acceptable solutions are all points of the polyhedron restrictions. Geometric solution to the problem of state mortgage housing projects based on PPP is a search for a point of making a polyhedron, the coordinates of which provide the maximum value of the objective function F(X).

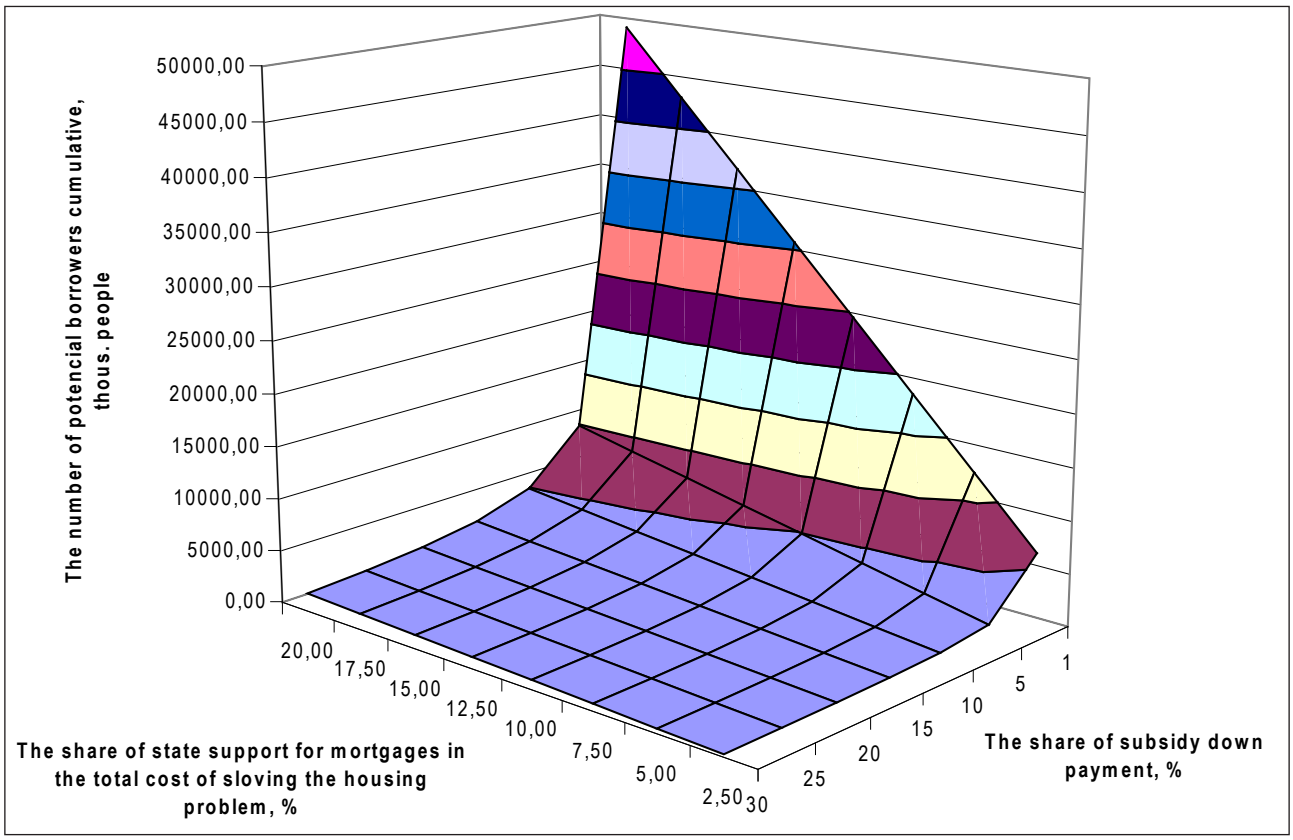

Figure 1: The plane making an economic and mathematical model under option subsidizing the initial payment on the mortgage loan

Initial data for modeling variants of state support for mortgage projects implemented on the basis of PPP for the period 2000-2015 by using Federal State Statistics Service data, which is selected to include and incorporate the results of the implementation of the federal program "Housing for 2002-2010".

Graphical solution of economic-mathematical model on the materials of the Russian Federation, making it possible to construct the plane of the developed model in two variants of state financial support of mortgage housing projects on the basis of PPPs, namely: 1) subsidizing the initial contribution (Figure 1) and 2) the interest rate subsidies (Figure 2) for mortgages.

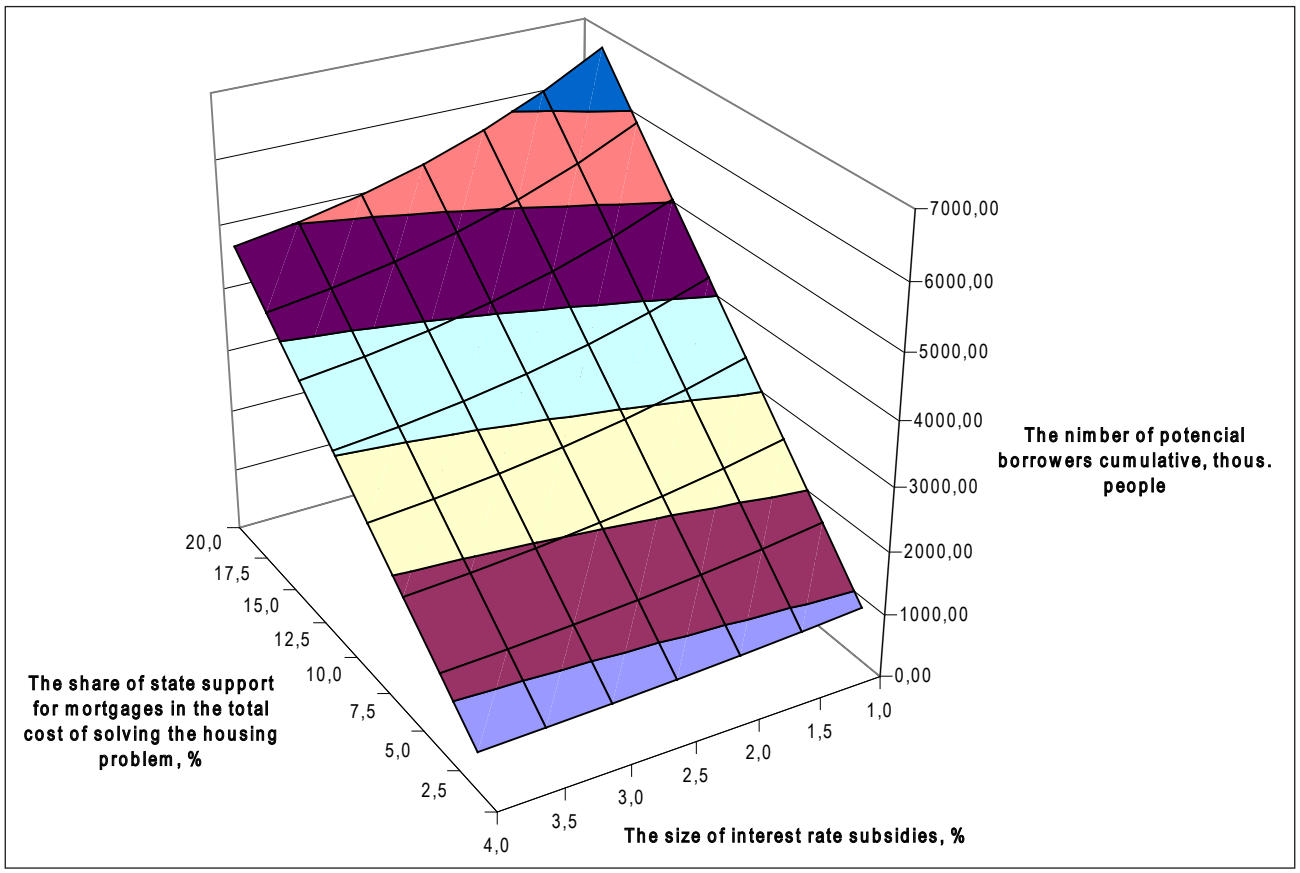

Figure 2: The plane making an economic and mathematical model under option subsidizing the interest rate on your mortgage

The analysis of the simulation results led to the conclusion about the effectiveness of variants of interest rate subsidies for mortgages, which allows to extend the range of potential borrowers and to get the maximum social and economic effect. The proposed option is recommended as a basis for policy-making in the area of public financial support for housing projects on the basis of PPP.

Introduction and practical implementation of the developed and proven methodologies for evaluating and economic-mathematical model for determining the optimal parameters of state support for housing projects on the basis of PPP provide systemic nature management decisions, will improve the accuracy of estimates of administrative decisions in the field of public housing policy through multivariate forecasting changes in its basic parameters and evaluate the effectiveness of the preferred and various options for solving the housing problem for the government, the banking sector and citizens.

Developed methodological framework for the assessment of efficiency of state support for housing projects on the basis of PPP can be predictive of housing supply, depending on social-economic factors, management decisions, to simulate possible scenarios for solving the housing problem, create a scientifically sound background to the development of practical recommendations to improve the government's housing policy.

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