ACCOUNTING PROFITABILITY AND RISK FACTORS FOR MODELING DECISION-MAKING ECONOMIC OPERATORS OF THE HOUSING AND UTILITIES SECTOR

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Abstract. The article presents an approach to improving the efficiency of economic entities in the housing and utilities sector. It based on taking into account factors of expected profitability and possible risks of its economic agents as potential investors in decision-making modeling depending on main characteristics of a particular object of modernization, as well as on adopted parameters of its financial support. In the subspace of the allowable combination of main object characteristics and estimated yield factors and potential risk values determined by calculation, many Pareto-optimal points formed for one or several economic entities to choose a particular investment scheme for the modernization of a housing and utilities sector.

Keywords: housing and utilities sector, economic entities, complex modernization, efficiency improvement, models, factors, profitability, risk.

Introduction

One of the modern features of housing and utilities sector sphere functioning is the growing number of economic entities and other organizational structures with private ownership. In order to promote competition between economic entities in the housing and utilities sector in the Russian regions, by 2020 it is planned that at least 50% of their number should be represented by private entities. To solve this problem, it is necessary to accelerate the process of large-scale privatization of economic entities in the housing and utilities sector. Considering that these processes are superimposed on the implementation of equally important and significant measures for the comprehensive modernization of the entire infrastructure of the housing and utilities sector, economists are faced with the necessity to adapt existing or to develop new models to increase the efficiency of their activities by economic actors in the housing and utilities sector [1, p.34].

In the conditions of transition of economic subjects of housing and utilities sector to the principles of market economy, the solution of the above problems is possible based on the usage of probabilistic demand models to determine the financial efficiency of specific projects for the modernization of infrastructure in this sector taking into account the factors of expected profitability and possible risks. One of the approaches of economic actors’ decision-making modeling in the housing and utilities sector to solve the problems we consider revealed below.

Purpose of the study

Justification of the approach and tools for modeling decision-making by economic actors in the housing and utilities sector during the comprehensive modernization of its infrastructure, taking into account the factors of profitability and risk.

Research methods

Today, the infrastructure of the housing and utilities present a sufficiently large number of objects, each of which operates through the work of one or several economic entities. Many infrastructure facilities in this area currently have significant moral and physical deterioration, which means they are require modernization and involvement of budgetary and extra-budgetary financial resources. Its modernization should be comprehensive and focused so that further operation of an object becomes more efficient. Only if condition is true, it is possible to consider an effective investment to this specific object.

Based on this, every \( x \in X \) object assigned to a financial vector parameter \( u \),
which can take on different values within a certain \( U(x) \) set. Essentially, this financial vector parameter is a set of characteristics that determine the financial efficiency of the modernization of a specific object under the accepted scheme of investing in its modernization. In our case, the financial vector parameter of the object include: total investment to the modernization of the object, volume of investments in modernization period of the object, volume of expected income for the period of operation of the object used in the calculations interest rates. It should be noted that total amount of investment to the modernization of the object is determined depending on the current state of the market and the characteristics of the object. Generally, it must be accurately determined until decision-making about investing in this object. The volume of investments by periods of modernization of the object, in most cases, known values, which determined by the financial capabilities of either a specific investor or a particular economic entity or the group acting as investors. At the same time, the volumes of expected incomes for the periods of operation of the object depend on both the interest rates taken during the calculations and the future market conditions. That is, these indicators can only be determined based on probabilistic estimates \([2, \text{p.83}; 3, \text{p.56}].\)

We denote the main financial parameter of a specific object – the rate of expected incomes for periods of operation – using \( C_i \). Then, given that the allowable set of \( U(x) \) values of financial vector parameter \( u \) depends on the main characteristics of a particular object \( x \), as well as in case of a constant rate of expected incomes for periods of operation \( C_i \), the correlation, which cost of investments \( (IZ_i) \) cannot be less than the cost of modernization \( (S_{m}(x)) \), so \( IZ_i > S_{m}(x) \).

To determine the optimal amount of investment and to assess possible risks in upgrading one or another infrastructure facility in the housing and utilities sector, it is necessary to build a probabilistic model of the project’s expected return and to determine the optimal value of its financial vector parameter. From a financial point of view, each object \( x \) is characterized by its profitability \( I_p(x,u), u \in U(x) \), which is a characteristic of the effectiveness of investment in the object \( x \) with financial vector parameter \( u \). At the same time, this parameter can take values from the set determined by the characteristics of the selected object.

In this case, probabilistic uncertainty takes place, to describe which we introduce a random variable \( \xi(x) \) – random efficiency. It can take the following values:

- \(-1\), if the object \( x \) with financial vector parameter \( u \) not fully modernized (comprehensively) – such situation may occur under the condition that investments to the objects made, but the expected income from their implementation has not been received, therefore the efficiency of the object will be \(-1\);

\( I_p(x,u), \) if object \( x \) with financial vector parameter \( u \) successfully completed a comprehensive upgrade.

Denote the probability of a comprehensive modernization of the \( x \) object with financial vector parameter \( u \) by \( p(x,u) \). Obviously, this value considered as expected demand for the modernization of the object \( x \), characterized by a set of basic parameters under a certain scheme for obtaining the expected income from the realization of investments to this object with a financial vector parameter \( u \in U(x) \).

Of course, our approach to the description of the main characteristics of the decision-making model by economic actors in the housing and utilities sector during the comprehensive modernization of its infrastructure has been greatly simplified. A more realistic approach is one in which the efficiency of upgrading an object can take all the values in the interval \([-1, \infty]\) with some probability distribution. In practice, this means assuming the possibility of a complete failure of the complex modernization of the facility, when the expected income from its further operation turns out to be zero, and the efficiency is equal to \(-1\), and also assuming successful implementation of a comprehensive modernization of the facility, when the expected income from its further operation can be as large as desired. Such an approach to modeling is also amenable to research, but technically, it turns out to be more difficult to understand. There-
Therefore, we will dwell on a variant of a simplified description of the parameters of the model, on the example of which it is possible to show all the main dependencies of the decision-making process we are examining by economic actors in the housing and utilities sector when conducting a comprehensive modernization of its infrastructure.

As is known, in most cases the probability of carrying out a complex modernization of an object is a value that is inversely proportional to the efficiency of its operation [4, p.117]. Since, as a financial parameter, we accepted the rate of the expected income by periods of operation of the object, then with a decrease in this parameter the probability of its successful modernization increases. However, with a decrease in the expected income for the periods of operation of the object, its overall profitability also decreases.

To prevent such a scenario, we introduce the concept of average profitability of an object \( I_u(x, u) \), which determined by the formula:

\[
I_u(x, u) = \frac{p(x, u) + (1 - p(x, u))(-1)}{p(x, u) + 1 + I_u(x, u)}. \tag{1}
\]

Given the nature of the dependence of the value of the financial vector parameter on the likelihood of carrying out a comprehensive modernization and obtaining the expected profitability from operating the facility, it is possible for any object to find a value of the financial vector parameter that maximizes the average yield. In other words, we need to solve the following problem:

\[
\overline{I}_u(x, u) = \max u \in U(x) \tag{2}
\]

The solution of the problem (2) denoted by \( u^*(x) \). The calculated value of this indicator will be the optimal value of the financial vector parameter of the object \( x \in X \) taking into account probabilistic uncertainty.

To obtain estimates of probability \( p(x, u) \) we can use the method of expert estimates with the subsequent analytical approximation or statistical data processing. These approaches are well known and many times described in various sources, so we will not emphasize on them. We only note that in the presence of an expert assessment of the probabilistic uncertainty of the complex modernization of the object \( p(x, u) \), can solve the problem (2) and get the maximum value of the average yield parameter for each specific object \( x \), and also to obtain the dependence \( u^*(x) \) of the optimal financial vector parameters for a certain set of modernized objects in the housing and utilities sector.

After for each \( x \) object will be determined optimal financial vector parameter \( u^*(x) \), it becomes possible to determine the average yield of a comprehensive modernization of a housing and utilities sector object under a certain scheme of its financing \( M(x) \). It is determined by the formula:

\[
M(x) = p(x, u^*(x))(1 + I_u(x, u^*(x)) - 1. \tag{3}
\]

The second characteristic of an object is the risk or potential losses that are associated with its comprehensive modernization. Since both characteristics are probabilistic in nature, it seems legitimate to introduce a random variable \( \eta(x) \), which characterizes the random yield of the complex modernization of the object at a certain financial vector parameter and can take the following values:

\[
\begin{cases}  
I_u(x, u^*(x)) & \text{with probability } p(x, u^*(x)) \\
\eta(x) & \text{with additional probability } -1 - p(x, u^*(x)) 
\end{cases} \tag{4}
\]

Then the risk associated with conducting a comprehensive modernization of the object can be determined by \( R(x) = M(x) - \eta(x) \), where \( (A^\dagger = \max (A, 0)) \). According to this formula, by risk we shall mean the average deviation of random returns from its expected value downward. From this definition, it follows that:

\[
R(x) = (1 + M(x))(1 - p(x, u^*(x))) \tag{5}
\]

Results and discussion

Thus, for each object \( x \) of housing and utilities infrastructure, subject to complex modernization, you can always define two main
characteristics: the average yield $M(x)$ and possible risk $R(x)$, which are calculated on the basis of the selected optimal financing parameter under the adopted investment scheme for the modernization of this object. The presence of a certain set of admissible values of these characteristics allows us to construct a set of Pareto-optimal points in the subspace $(M(x), R(x))$, which at $x \in X$ cover all possible combinations of financing the modernization of a specific object $x$ of housing and utilities sector [5, p.172]. The values of the financial parameter in each of the points of the Pareto set are quite clear recommendations for making decisions on investing the modernization of one or another housing and utilities sector object for a potential investor, economic subject or their combination.

**Conclusions**

Because of the study, a number of results obtained, based on which the following conclusions formulated:

1. In order to increase the efficiency of activities, economic entities in the housing and utilities sector in the context of its comprehensive modernization need to solve the difficult task of adapting existing or developing new models for making effective decisions.

2. This article presents one of the possible approaches to solving this problem, which based on the usage of probabilistic demand model for determining the financial efficiency of upgrading specific objects, as well as estimating expected returns and possible risks.

3. The potential investor guided by the characteristics of the average profitability and possible risk, as well as the set of acceptable values of Pareto-optimal points calculated based on a certain financial parameter of the object - the accepted scheme of financing its modernization.

**Gratitude**

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**Библиографический список**


УЧЕТ ФАКТОРОВ ДОХОДНОСТИ И РИСКА ПРИ МОДЕЛИРОВАНИИ ПРИНЯТИЯ РЕШЕНИЙ ЭКОНОМИЧЕСКИМИ СУБЪЕКТАМИ СФЕРЫ ЖИЛИЩНО-КОММУНАЛЬНОГО ХОЗЯЙСТВА

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Аннотация. В статье представлен подход к повышению эффективности деятельности экономических субъектов сферы жилищно-коммунального хозяйства. Он основан на учете факторов ожидаемой доходности и возможного риска ее экономическими субъектами как потенциальными инвесторами при моделировании принятия решений в зависимости от основных характеристик конкретного объекта модернизации, а также принятых параметров его финансового обеспечения. В плоскости допустимого сочетания основных характеристик объекта и определенных расчетным путем значений факторов ожидаемой доходности и возможного риска формируется множество Парето-оптимальных точек для выбора одним или несколькими экономическими субъектами конкретной схемы вложения инвестиций в модернизацию того или иного объекта сферы жилищно-коммунального хозяйства.

Ключевые слова: жилищно-коммунальное хозяйство, экономические субъекты, комплексная модернизация, повышение эффективности, модели, факторы, доходность, риск.