Comparative Efficiency of Economic Security Tools for Innovative Projects

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Abstract: - Insurance, which is the method of economic protection of projects, widespread in industrialized
countries, cannot fully balance various types of threats due to the high level of uncertainty, characteristic of
developing economies. At the same time, the use of other protection methods, such as redundancy, is justified
only in the presence of certain conditions and a certain state of the external environment. A dynamic model of
decision support when choosing the most effective method of economic protection of an innovation project,
which also takes into account risks, the amount of investment and the amount of possible damage, is proposed
herein. The model establishes the relationship between the marginal value of the insurance rate and the factors
affecting the implementation of the project. The solution makes it possible to develop the most optimal
economic protection strategy.

Key-Words: - economic security, reservation, insurance, risks, uncertainty, cost of capital, innovative project.

1 Introduction
Currently, in industrialized countries, financial
capital often does not bring acceptable returns to
investors [1]. Investments in financial instruments
after a succession of crises can be considered quite
risky investments [2]. Not only securities have
significant volatility, but also many commodities:
metals, oil, grain, etc. This circumstance forces
investors to invest their capital in the markets of
developing countries with an intensive growth of the
economy and favorable conditions for the
implementation of innovative projects [3]. At the
same time, the risks characteristic of this kind of
projects are superimposed on the uncertainty
associated with changes in the economic system [4], and therefore the task of economic protection of investments [5] becomes relevant. Therefore, capital-intensive projects in developing economic systems are the main object of the study. The task of choosing an effective method of economic protection of the projects, the results of which are complex technical objects (CTOs), is particularly relevant [6].

These and other reasons determined the purpose of this study – the identification of the selection criteria for the most effective method of economic protection of innovative projects. For this, it is necessary [7, 8, 9]: to determine the order of application of various methods for the economic protection of projects; to identify the features of the developing economic system in which the project is expected to be implemented; to analyze the factors affecting the implementation of the project; to develop economic and mathematical models to make decisions on the organization of the economic protection of the project.

2 Literature Review

Research in the field of protection of innovative projects and ensuring their safe development was carried out by many scientists [10, 11, 12]. Special attention is paid to one of the most common methods – insurance [13, 14, 15]. In developed countries, this method is the most common [16]. The debugged system, consisting of a multitude of insurance organizations, brokers and agencies, allows interested parties to conclude an insurance contract that is optimal for a set of services and tariffs. The features of insurance of large high-tech projects have been reviewed by Anyushina [17]; the practical aspects have been disclosed by Mustafina [18].

In developing countries, the insurance organizations prefer, as a rule, to conclude contracts in those activities where, according to their assessment, the probability of occurrence of insurance events is insignificant and the possible damage is minimal [19]. Moreover, subject to the occurrence of an insured event, the payment of compensation is usually delayed to the maximum or sometimes not carried out at all [20, 21]. Involvement of insurance companies from developed countries in the protection of a project is not always possible. Under these conditions, insurance companies, as a rule, compensate additional costs with higher tariffs. Various problems of insurance protection of investments made in the form of capital investments are discussed in the scientific works [22, 23], where it is noted that the lack of comprehensive investment insurance programs leads to unreasonable overstatement of tariffs. These circumstances force the investor to look for other ways of economic protection of the project. Alternatively, the possibility of creation of a special reserve fund (SRF), which can be used to compensate for damage, is considered.

To increase the investment attractiveness of the projects, some researchers suggest using a public-private partnership mechanism [24, 25] – it is noted that additional resources or reserves are required to neutralize the risks. In some papers, general principles of a systemic approach to reserving have been proposed and the most significant factors influencing the development of a reserving strategy have been identified, which include the cost of equipment, objects of labor, the physical properties of reserved resources, etc. [27, 28, 29].

When choosing the methods of economic protection, the state of the external environment in which the project is implemented is of great importance. This problem was studied in the scientific work by Gatti [29]. In the works [30, 31], the widely used insurance models for various occupational risks are analyzed. The implementation of projects using the results of fundamental and applied research is associated with innovation risks [32, 33]. The literature review shows that in developing countries, the most likely threats to investors include: the supply of materials and components that do not meet technical specifications; violation of the production technology, testing and operation of the products; production accidents, storage and transportation of products; manufacturing defects, latent defects; unforeseen changes in the exchange rates, bank interest rates, inflation and other factors that adversely affect the financing of the project.

Methods of economic analysis and dynamic programming are most often proposed for building models [34, 35]. To solve the problem in question, from the authors' point of view, it is most appropriate to use economic and mathematical methods to determine the optimal amount of funds needed to neutralize the risks of implementing innovative projects.

3 Methods

3.1 Comparison criterion

The problem of choosing the most effective method of economic protection is associated with
differentiation of the marginal insurance rate when the insurance becomes unprofitable [36]. It is advisable to solve this problem with the help of a model that estimates the change in the cost of capital during insurance and financial reservations.

The model, offered by the authors, functions as follows: let us suppose that at the beginning of the year the enterprise (the Insured) chooses the insurance and transfers the insurance premium to the insurance company (the Insurer). At the end of the year, the cost of capital will be:

\[ C_{i+1} = C_i - S + a \cdot (C_i - S), \]  

(1)

where \( C_{i+1} \) is the cost of capital of the enterprise at the end of the year, \( C_i \) is the cost of capital of the enterprise at the beginning of the year, \( S \) is the insurance premium transferred to the Insurer’s account, and \( a \) is the average return on the assets of the enterprise.

In the case of choosing a financial reserve, the company assumes all risks and possible payments will reduce the cost of capital. At the beginning of the year, the funds are withdrawn from the company to the SRF and placed in the financial market in highly liquid assets. At the end of the year, the cost of capital of the enterprise will be:

\[ C_{i+1}^R = C_i + r \cdot (Y - X) + a \cdot (C_i - Y), \]  

(2)

where \( C_{i+1}^R \) is the cost of capital at the end of the reporting period in the case of organization of a financial reservation, \( Y \) is the value of SRF, \( X \) is the expected loss upon the occurrence of negative events, \( r \) is the average profitability of the financial market in which the SRF is located.

The expected losses are the average losses for the insurance events for the past period. If the amount of damage is less than the amount of SRF, then its balance will continue to operate in the financial market and will generate income. The investor decides in favor of the method of economic protection that ensures the maximum cost of capital.

The method of measuring the cost of capital makes it possible to substantiate decision-making in the implementation of innovative projects at existing enterprises that produce serial products, but it is not quite suitable as a tool for evaluating the effectiveness of protecting capital-intensive innovation projects with a relatively long term for designing and manufacturing CTOs.

The developed model of economic protection of projects is based on comparing the values of the present income of an innovative project protected by insurance, \( NPV_r \) is the net present value of an innovative project protected by insurance, \( NPV_r \) is the net present value of an innovative project protected by insurance, \( NPV_r \) is the net present value of an innovative project protected by reservation.

Compliance with the condition (3) gives the grounds for choosing insurance as a method of economic protection. \( NPV \) of the project, protected by insurance, will include not only the investments but merely the insurance payments, which will be transferred to the Insurer under the terms of the contract:

\[ NPV_{ins} = \sum_{i=1}^{n} \frac{CF_i}{(1+r)^t} - \frac{T}{1-(1+r)^{m}} - IC, \]  

(4)

where \( CF_i \) is the net cash flow generated by the project, \( r \) is the discount rate, \( n \) is the number of periods of economic protection planning, \( m \) is the beginning of operation of the CTO, \( T \) is the insurance premium paid to the Insurer, \( IC \) is the invested capital.

\( NPV \) of the project protected by reservation takes into account the funds allocated to the reserve fund:

\[ NPV_r = \sum_{i=1}^{n} \frac{CF_i}{(1+r)^t} - (IC + ICr), \]  

(5)

where \( ICr \) is the capital directed at the creation of a reserve.

### 3.2 Maximum Insurance Rate

#### 3.2.1 Simple tariff estimate

The model allows determining not only the most effective method of economic protection but also the limiting value of the insurance rate for this project. The following assumptions were taken by the authors to obtain the result in a simplified form:

a) financial resources come in a lump sum and are spent all at once, although in practice various financing options are possible;

b) the invested capital in the main and reserve objects in the model is considered to be the same, although the resources to create a reserve CTO will be required less by the amount of previously performed design work (\( IC = ICr \)).

The insurance premium is formed as the product of the insurance tariff for the value of the insured property:

\[ T = t \cdot IC, \]  

(6)

where \( T \) is the insurance premium, \( t \) is the insurance tariff, \( IC \) is the value of the property, equal to the investments directed to the creation of the CTO.

After taking into account the assumptions (6) in the expressions (4) and (5), the following is obtained:

\[ NPV_{ins} = \sum_{i=1}^{n} \frac{CF_i}{(1+r)^t} - IC(\frac{t}{1-(1+r)^{m}} + 1), \]  

(7)
The presented model makes it possible to choose the most effective method of economic protection of unique projects that have no further continuation.

3.2.3 Tariff assessment taking into account the sale of the reserve complex technical object

If further development of the direction is forecasted, implying the production and sale of a similar type of complex technical object, then it becomes possible to sell a reserve object in the market in the event of a favorable outcome of events. In this case, the expression (5) takes the form:

$$\text{NPV}_{\text{sale}} = \sum_{i=m}^{n} \frac{CF_i}{(1+r)^i} - 2IC + P$$

(17)

The reserve CTO can be modified upon request of the customer or sold with a discount ($d$). Due to the fact that income can be obtained only after the risks, associated with putting the main CTO in operation, decrease significantly, the model should include the discounting of funds received from future sales and the likelihood of a favorable outcome ($1-p$). The implementation of the reserve CTO will bring income in the amount of:

$$P = (1-p) \cdot \frac{JC \cdot (1-d)}{(1+r)^\ast}$$

(18)

After application of (18) in the expression (17), the following dependence is obtained:

$$\text{NPV}_{\text{sale}} = \sum_{i=m}^{n} \frac{CF_i}{(1+r)^i} - 2IC + (1-p) \cdot \frac{JC \cdot (1-d)}{(1+r)^\ast}$$

(19)
After the transformation, the following dependence is obtained:

\[ NPV_i = \sum_{i=1}^{n} \frac{CF_i}{(1+r)^t} - IC \cdot \left[2 - \frac{(1-p) \cdot (1-d)}{(1+r)^t}\right] \]  

(20)

After the equation of (14) and (20):

\[
\sum_{i=1}^{n} \frac{CF_i}{(1+r)^t} - IC \cdot \left(\sum_{i=1}^{n} (1+r)^{-i} + 1\right) - p \cdot Q = 0
\]

(21)

After the transformation, the following expression is obtained:

\[
t \sum_{i=1}^{n} (1+r)^{-i} = 1 - p \cdot \frac{Q}{IC} - (1-p) \cdot (1-d) \cdot (1+r)^{-i}
\]

(22)

from which the limit value of the insurance rate can be found:

\[
t = \frac{[1 - p \cdot \frac{Q}{IC} - (1-p) \cdot (1-d) \cdot (1+r)^{-i}]}{\sum_{i=1}^{n} (1+r)^{-i}}
\]

(23)

4 Results and Discussion

The organization of the economic protection of projects for the creation of the CTO by the method of reservation may be preferable to insurance in some cases. Subject to occurrence of a negative event, the reserve funds are immediately sent to compensate for the damage, while it takes considerable time to obtain the insurance compensation. Therefore, a dynamic model of decision making, which takes into account all the time spent on the innovation process, is proposed to choose the methods of economic protection.

The authors introduce the following values into the initial conditions of the model:
- the probability of irretrievable loss of special relativity – \( p = 0.05 \);
- the ratio of losses due to lost income and investment – \( Q / IC = 0.2 \);
- the size of the discount in the implementation of the CTO or the cost of its modernization from investments in the project – \( d = 0.2 \)
- the period of development of the CTO – \( n = 5 \) years.

For the discount rate, the authors apply the capital return rate (Km), calculated as the sum of the risk-free investment rate and market risk, which depends on the level of development and stability of the economic system.

The model shows that in a stable economy, where the rate of return on capital (discount rate) is within 6-9%, the insurance rate is at an acceptable level and does not exceed 8% of the sum insured.

Table 1. The limit of insurance rates for the group of industrially developed countries with sustainable economies

<table>
<thead>
<tr>
<th>Industrially developed countries with sustainable economies</th>
<th>Discount rate, %</th>
<th>Maximum insurance rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>6.8</td>
<td>6.16</td>
</tr>
<tr>
<td>USA</td>
<td>8.3</td>
<td>7.31</td>
</tr>
<tr>
<td>Japan</td>
<td>7.2</td>
<td>6.45</td>
</tr>
<tr>
<td>France</td>
<td>7.3</td>
<td>6.53</td>
</tr>
<tr>
<td>EU</td>
<td>8.76</td>
<td>7.68</td>
</tr>
</tbody>
</table>

For developing economies, where the discount rate is taken in the amount of 11-17% [37], the limit value of the insurance rate can reach 14%, which may not always be acceptable to the Investor.

Table 2. Insurance tariff limits for the developing countries

<table>
<thead>
<tr>
<th>Developing countries</th>
<th>Discount rate, %</th>
<th>Maximum insurance rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico</td>
<td>15.5</td>
<td>12.98</td>
</tr>
<tr>
<td>Indonesia</td>
<td>16.2</td>
<td>13.54</td>
</tr>
<tr>
<td>Malaysia</td>
<td>11.4</td>
<td>9.76</td>
</tr>
<tr>
<td>India</td>
<td>14.8</td>
<td>12.43</td>
</tr>
<tr>
<td>South Africa</td>
<td>16.4</td>
<td>13.69</td>
</tr>
<tr>
<td>China</td>
<td>11.5</td>
<td>9.83</td>
</tr>
<tr>
<td>Russia</td>
<td>16.8</td>
<td>14.01</td>
</tr>
<tr>
<td>Brazil</td>
<td>15.4</td>
<td>11.4</td>
</tr>
<tr>
<td>BRICS</td>
<td>14.9</td>
<td>12.51</td>
</tr>
</tbody>
</table>

For countries that are in conditions of external or internal instability, the discount rate is higher than 18% [37], which makes the project’s insurance protection organization dubious due to high tariffs (see Table 3).

Table 3. Limiting size of insurance tariffs for countries with unstable economies

<table>
<thead>
<tr>
<th>Countries with unstable economies</th>
<th>Discount rate, %</th>
<th>Maximum insurance rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>35.8</td>
<td>29.43</td>
</tr>
<tr>
<td>Venezuela</td>
<td>36.3</td>
<td>29.82</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>19.3</td>
<td>16.52</td>
</tr>
</tbody>
</table>

E-ISSN: 2224-2899 364 Volume 16, 2019

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The reduction of the insurance rate will damage the insurance organization, which will be unable to collect reserves and, accordingly, will be unable to compensate for the damage under the concluded insurance contracts.

The diagram (Fig. 1) shows the insurance rates that correspond to the level of development of the economic system.

<table>
<thead>
<tr>
<th>Argentina</th>
<th>25.0</th>
<th>20.97</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ukraine</td>
<td>18.2</td>
<td>15.67</td>
</tr>
<tr>
<td>Iran</td>
<td>24.4</td>
<td>21.28</td>
</tr>
<tr>
<td>Group average</td>
<td>26.5</td>
<td>22.14</td>
</tr>
</tbody>
</table>

According to the analysis, the value of the insurance tariff depends on the discount rate, which, in turn, is determined by the level of risks in the economy as a whole. In developing economies, there is a high level of uncertainty in the environment in which an innovative project is implemented, and therefore the use of insurance as an instrument of economic protection may not always be justified.

Previously conducted research in the field of economic protection of projects was focused, as a rule, on a particular method and evaluated the possibility of its use in a particular sector of the economy [38, 39]. In contrast, the article presents an effective tool for making decisions on the organization of economic protection, firstly, in various industries, secondly, with a relatively small amount of input information.

5 Conclusion

The analysis carried out herein showed that in the practice of organization of the economic protection of innovative projects in the developing economic systems, such methods as property insurance, self-insurance and reservation are most actively used. These methods are well studied, but the lack of a decision-making mechanism for their selection significantly reduces the practical level of economic security of the project. In conditions of uncertainty, the timing of the project and its final result depend on the choice of a method of economic protection. This article presents a dynamic model that takes into account the state of the external environment, the risks, the amount of investment and the amount of possible damage. The model establishes the relationship between the marginal value of the insurance rate and factors affecting the implementation of the project. The developed model makes it possible to improve the quality of management decisions when choosing the method of economic protection of an innovative project.

6 Acknowledgement

The study was carried out with the financial support of the Russian Foundation for Basic Research under the project No. 17-06-00373.

References


