Risk and uncertainty in economic modelling of complex building systems

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Abstract. In the article the authors consider the possibility of applying the tools of econometric modeling with variable structure, in the analysis of complex economic building systems that take into account sudden shifts due to a perturbing influence of factors of risk and uncertainty and thus to increase the efficiency of select and justify management decisions

1 Introduction

The relevance of the study is, traditional econometric models assume that the original dependent and independent parameters are quantified and permanent, and their relationship between them does not change neither in time nor in space. However, in the analysis of real complex economic systems and processes we have to admit that as a result of influence of external and internal factors, and the degree of impact between qualitative and quantitative dependent and independent variables change. In such cases, traditional models with fixed structure are not precise enough to explain the changing patterns of phenomena and their analysis the model should be used with variable structure, which will capture changes the values of the coefficients in the planning and management of complex systems.

Features of the account of risk factors and uncertainties in the modeling of complex economic systems will be considered on the example of the investment-construction complex. Investment-construction complex is an integral part of the economic complex of Russia interacting with other sectors of the economy, which are created and updated fixed assets intended for the development of social production and solution of social, economic and technical problems of the economy of the whole country.

The construction, how sphere of material production, organically connected with the suppliers of raw materials, transport companies, General contractors and subcontracting companies, project organizations, investors, banks, consumers of finished building products (natural and legal persons), etc.

Production cycle of investment-construction complex is a complex process for the formation of the final product, which can be grouped into several so-called organizational and economic redistribution, that is collectively rational development of production processes (main, auxiliary, servicing), use of main types of resources (human, material, technical, etc.), functioning of enterprises in various industries, forms of ownership and destination, required to obtain the final product typical of these enterprises [1-10].

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2 Materials and methods

In the framework of the i-th organizational-economic redistribution, enterprises investment-construction complex to decide local problems of strategic and tactical nature, with the aim of optimizing the basic parameters of its activities (optimization of cost and time; efficiently using resources and getting the maximum effect from implementation of investment construction project). But since each facility of the complex is an open system, it is subject to the continuous influence of factors external and internal environment, resulting in the production processes and key production parameters within each of the processing significantly deviate in time and space from normal in its development, and as a consequence result in losses.

Due to the specific characteristics of each of the i-th organizational-economic redistribution of the production cycle (OER_i), certain factors manifest themselves to a greater or lesser extent. However, each factor, taken in isolation, does not identify a particular risk in its entirety, and only a set of generating risk factors, their interconnection, will form a more or less complete idea about the nature of the phenomenon under study. On this basis, it is necessary to define the possible risks for each redistribution and to form factor space for further qualitative and quantitative processing.

At the initial stage of formation of the factor space it is necessary to use a method of individual expert assessments.

Experts quantitatively evaluate the degree of importance of identified risk and system risk factors on the adopted scale of 0 to 1, where 0 is no impact. *

3 Results

The results of the quantitative evaluation and importance of identified risk and system risk factors are shown in tables 1 and 2. The obtained results have the necessary accuracy and consistency of expert opinions is satisfactory.

The revealed dependences allow to substantiate the necessity of taking into account the specific factors in the management of investment-construction complex.

According to the results of the expert survey is necessary to exclude those risk groups within OERi and risk factors, the significance of which in the opinion of the expert group is less than 0.2, which describes weak influence on the resulting indicator of the performance of the difficult economic construction system.

Thus, further consideration was excluded by a group of external unpredictable risks, as factors that define this group are often not amenable to prediction and in cases of their manifestation, it is advisable to create a trust reserve Fund; group internal technical risks

- for OER -1; group market risk (external predictable risks), financial risk (internal non-technical risks)
- for OER -2; market risk group (external predictable risks)
- for OER -3; group - internal technical, organizational and management risks (internal non-technical risks)
- for OER -4, as well as some of the factors whose significance according to the results of the study reaches 0.2, because they are, as a rule, are components of more significant risk factors.

Risk and uncertainty in economic modeling of complex construction systems, must be carried out in accordance with the algorithm shown in figure 2, which shows the phasing, the specifics of each stage, organizational and economic redistribution of the production cycle.

Table 1. The results quantify the importance of the identified groups of risks.

OERi	Risk group	The degree of influence on OERi
OER -1 "Production and manufacture of all kinds of raw materials, semi-finished products, materials necessary for the implementation of the production process"	External unpredictable risks	0,05
	External predictable risks: market risk	0,25
	Internal technical risks	0,15
	Internal non-technical risks: financial risk	0,25
	Internal non-technical risks: management risk	0,3
OER -2 "The movement and supply of all resources necessary for the implementation of the production process"	External unpredictable risks	0,1
	External predictable risks: market risk	0,15
	Internal technical risks	0,25
	Internal non-technical risks: financial risk	0,15
	Internal non-technical risks: management risk	0,35
OER -3 "The production process and the rational concentration of all types of resources"	External unpredictable risks	0,05
	External predictable risks: market risk	0,1
	Internal technical risks	0,25
	Internal non-technical risks: financial risk	0,2
	Internal non-technical risks: management risk	0,35
OER -4 "The yield of the finished product to the market and its implementation"	External unpredictable risks	0,05
	External predictable risks: market risk	0,35
	Internal technical risks	0,1
	Internal non-technical risks: financial risk	0,35
	Internal non-technical risks: management risk	0,15

Table 2. The results quantify the importance of system risk factors.

Risk group	Factor	The degree of importance of
External predictable risks: market risk	the increase in the cost of raw materials	0,3
	customer expectations	0,1
	the ratio of supply and demand	0,15
	the market price	0,2
	the policy of the competitors	0,15
	changing market	0,15
Internal technical risks	technology change	0,6
	specific risks of technology use in the project	0,3
	errors in design estimates; wear of fixed assets	0,1
Internal non-technical risks: financial risk	the disruption plan works	0,05
	wrong supply strategy	0,15
	unqualified personnel	0,07
	overpayment of materials, services	0,1
	errors in the estimates	0,03
	the inefficient payments system with third-party organizations	0,15
	downtime and inefficient use of resources (financial, human, logistical);	0,25
	violation of contractual terms of delivery	0,15
	unaccounted external factors	0,05
Internal non-technical risks: management risk	the lack of a developed insurance system and financial and business operations	0,1
	low reliability of suppliers, transport companies and other participants of the investment-industrial complex	0,16
	inefficient marketing strategy and pricing policy	0,27
	the lack of rationality on the methods used to organize and manage the production cycle and investment industry complex;	0,25
	the low efficiency of planning and operational management of works	0,1
	irrational concentration of labor collectives of the organizational-economic stages of the production cycle	0,05
	unqualified personnel	0,03
	the presence of incidents and sabotage	0,01
	errors of planning and design	0,09
	the lack of coordination of work	0,04

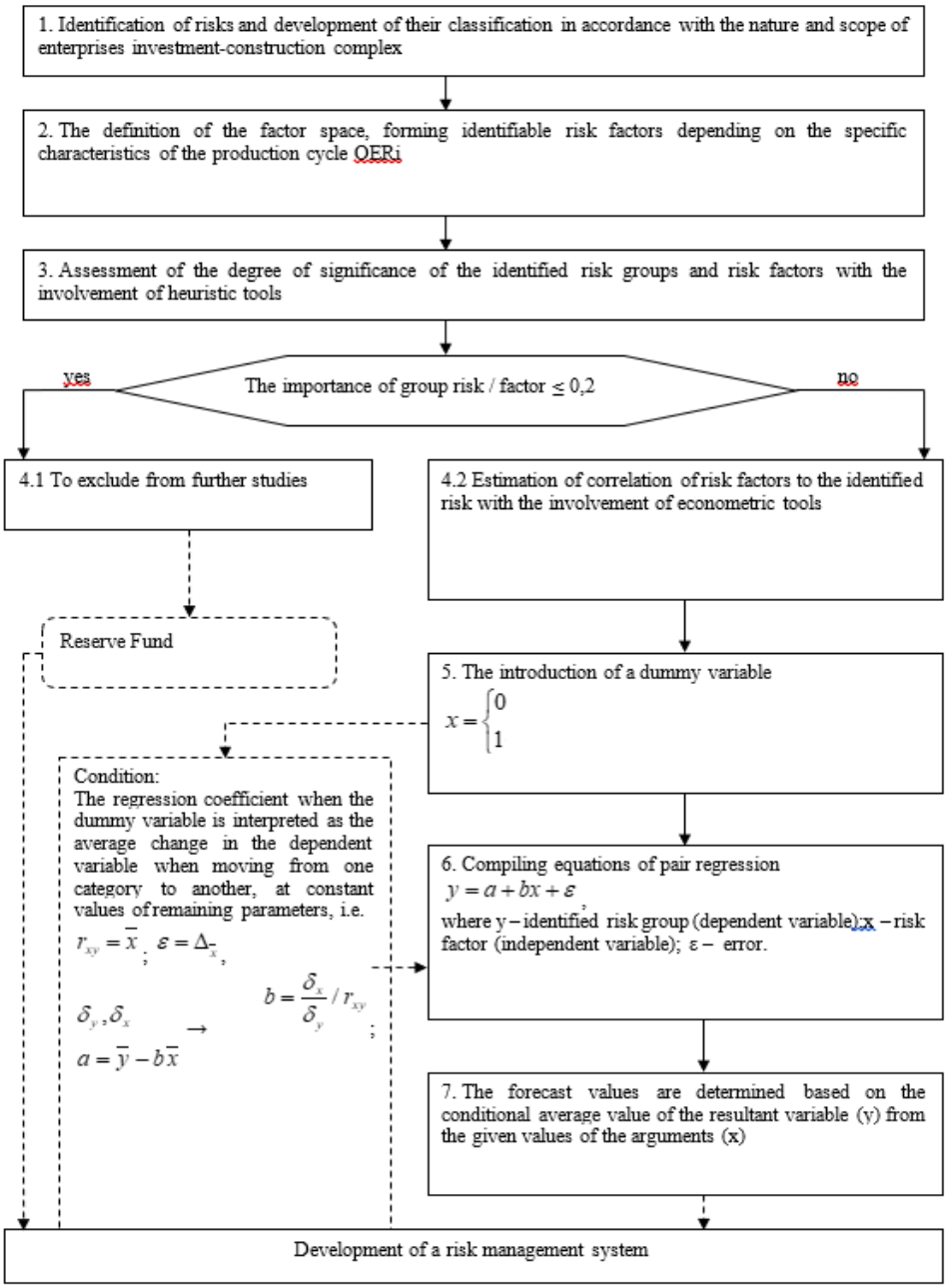

Fig. 1. The algorithm taking into account risk factors and uncertainty in economic modeling of complex building systems.

The result was obtained econometric dependence of the conditional average value of the resultant variable y (the level of the i-th risk group) from the given values of the arguments x (the degree of i-th significant factor) (Table 3).

Table 3. The results of correlation and regression analysis of the influence factor space at risk on OERi.

OERi	y (n)	x (n)	y = a + bx
OER-1	y1 (0,25)	x1 (0,3)	y=0,03+0,73x
		x2 (0,2)	y=-0,234+2,42x
	y3 (0,25)	x5 (0,25)	y=-1,04+5,17x
	y4 (0,3)	x6 (0,27)	y=-0,71+3,75x
		x7 (0,25)	y=-0,57+3,47x
OER-2	y2 (0,25)	x3 (0,6)	y=-0,72+1,61x
		x4 (0,3)	y=-0,11+1,2x
	y4 (0,35)	x6 (0,27)	y=-0,48+3,08x
		x7 (0,25)	y=-0,36+2,86x
OER-3	y2 (0,25)	x3 (0,6)	y=-0,68+1,56x
		x4 (0,3)	y=-0,1+1,17x
	y3 (0,2)	x5 (0,25)	y=-1,11+5,25x
	y4 (0,35)	x6 (0,27)	y=-0,6+3,67x
		x7 (0,25)	y=0,1+3,4x
OER-4	y1 (0,35)	x1 (0,3)	y=0,1+0,82x
		x2 (0,2)	y=-0,19+2,7x
	y3 (0,35)	x5 (0,25)	y=-0,4+2,99x

* y (n), where n is the degree of importance of the i-th group risk; x (n), where n is the degree of importance of the i-th factor for the i-th group of risk; y1 - market risk (external predictable risks); y2 - internal technical risks; y3 - financial risk (internal non-technical risks); y4 - organizational and management risk (internal non-technical risks);x1 - The increase in the cost of raw materials; x2 - Fluctuation of market prices; x3 - Technology change; x4 - Specific risks of technology use in the project; x5 - Downtime and inefficient use of resources (financial, labor. logistics); x6 - Inefficient marketing strategy and pricing policy; x7 - The lack of rationality used methods of organization and management of production cycle and investment-construction complex.

4 Conclusions

Thus, the establishment and analysis of the relationship between the dependent (yi) and independent variables (xi) allow to draw the following conclusions:

1) depending on the specific features of the i-th organizational and economic redistribution, the risk will manifest itself to a greater or lesser extent;
2) identified risk groups formed by a combination of factors, the significance of which varies in the interval from 0 to 1. Factors, the significance of which is less than 0.2, as a rule, form factor a higher degree of significance.
3) depending on the degree of manifestation of the i-th factor, which is included in a particular group, the risk level will be modified in greater or lesser degree. This relationship can be described using a linear equation regression of the pair y = a + bx, where y – the level of risk of the i-th group (the dependent variable); x – a risk factor that generates the i-th group (independent dummy variable). The linear coefficient b in the equation of the pair regression, shows how to change the level of risk of the i-th group under the meaningful manifestation of the i-th factor. For example, if the disturbance factor x5 "Downtime and inefficient use of resources (financial, human, logistical)" on the third organizational-economic redistribution will come from the interval of allowed values and will be on the conditional risk scale 0.3, then the level of financial risk (y3) will change to the 5.25 conventional units and by conventional scale of risk will be 0,465 that corresponds to the zone of critical risk.
4) obtained during the investigation of the dependence of the conditional average value of the resultant variable (y) from the given values of the arguments (x), allow us to determine the forecast values and take them into account when designing a system of enterprise risk management of investment-construction complex, with taking into account the specifics

of organizational and economic redistribution of the production cycle, and thereby to increase the efficiency of select and justify management decisions.

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