Economy

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USAGE OF STATISTICAL METHODOLOGY IN THE RISK ASSESSMENT

Summary. The article examines the nature and methods of quantitative risk assessment. The methodology of assessment of internal business risks on the basis of statistical methods is proposed. The application of the proposed methodology on the basis of data on the functioning of the machine-building industry of Ukraine is demonstrated.

Keywords: risk, risk assessment, statistical methods of risk assessment, machine-building.

I. Introduction

Business activity is always associated with a certain risk. Adequate knowledge of the risk and factors that affect its degree is the essential tool that can determine the effectiveness of functioning of the enterprise. Therefore, the modern management concept is impossible without the creation and implementation of comprehensive methodology of assessment and management of risks.

In order to ensure successful risk management enterprises develop complex of measures that are closely interconnected and together represent the process of preventing and reducing risks' impact on economic activity. One of the stages of this process is quantitative risk analysis.

II. Formulation of the problem

Economic literature describes a large number of risks' assessment methods [1-5]. However those descriptions are limited only to characteristics of methods and refrain from recommendations as to which one to use in the analysis of a project or enterprise as a whole. Thus, in this paper we are proposing an optimal risk assessment methodology and giving an example of its usage on the basis of the data on one of the branches of the Ukrainian economy.

III. Results

In order to choose method of evaluation which is better to use, we conducted an expert survey among enterprises of machine-building industry of Odessa region. The task of this survey was to identify characteristics and qualities, which according to the respondents should include in itself the "ideal" method of risk assessment. Grouped results of the study can be represented as a list of key parameters that characterize a particular method of risk assessment. The list of parameters includes: minor financial cost, small investment of time, a high level of objectivity of the method and so on [1, 6].

It is clear that each method does not have all of positive characteristics but has only several of them. However, to choose the best method it is not enough for a method to have the majority of positive parameters, because most parameters are not equivalent to each other.

Thus, we offered respondents to rank the characteristics in order to compare quantitative risk assessment methods between each other. As a result of this comparison we obtained final priority score of each method.

Statistical method of quantitative risk assessment was ranked as the first among others methods and identified as the most appropriate for usage. The second place was taken by the method of financial ratios; third place was shared between the method of expert estimations and method of analysis of feasibility of costs. Last place was taken by underdeveloped in national economic conditions unique method of analogies.

This analysis showed the most propitious methods of quantitative risk assessment. However, separate usage of them won't give reliable results about the influence of risk on the enterprise. Literature analysis [1,3,7,8] and management consulting shown that chosen methods should have the most significant advantages and minor disadvantages and we must apply them not separately, but in combination, because it is possible to address the shortcomings of one method by applying other methods.

So, authors propose a new approach to the evaluation of economic risk, which is based on the integrated usage of quantitative methods of analysis that is the

combinational method. The components of combinational evaluation are: statistical method, the method of fault tree, method of financial ratios and method of expert estimations. In other words we propose to use methods that occupied high places in the analysis of parameters.

Application of elements of the statistical method can detect risk situations. On the other hand this method does not identify the specific risks of the company and considers risk as a single magnitude. To eliminate this disadvantage we use the fault tree which helps to identify the totality of risks faced by the company during its operations. But the tree is not able to specify the amount of risk that indicates the need to use other methods. Method of financial ratios is based on the financial performance of the company and can give an accurate assessment of the risks of internal functioning of the organization. The method of expert estimations will assess the risks arising at the macro level of functioning of enterprise.

Thus we can represent a comprehensive risk assessment algorithm and demonstrate its use on the example of six machine-building enterprises of Odessa region. These enterprises include: JSC “Holding company “Micron”, JSC “Stankonormal”, Southern electrical company Ltd., JSC “Odessa radial drilling machines factory”, industrial association “Holodmash” and JSC “Odessa press-forging plant”.

So, the first step is the identification of the risk situation at the enterprise. During this step, with the help of statistical indicators of analysis of time series we can track changes within the basic elements of the company that will help to determine the positive or negative trends that are distinctive to its functioning.

Summarizing conducted analysis of data during the first stage we note that the functioning of whole totality of studied enterprises could be characterized by downward trends of production, profits and number of employees. Additionally we were able to identify commercial and qualification risks, fuel and energy risks, commodity risks, numerous financial risks, including: the risk of unused capacity, investment and credit risks.

Second step of our method is statistical analysis of risks at the enterprise [9-12]. At this stage, we calculate main indicators of method of statistical research i.e. standard deviation and coefficient of variation.

Since machine-building enterprises that are included in the analyzed population, differ by volume of their production, as well as by volumes of profits or losses, we decided to split businesses into two groups. The first group of enterprises has profits from the sales bigger than 15 mln. UAH and the second one, consequently, smaller than 15 mln. UAH. As an indicator of risk assessment was chosen indicator of the volume of profit from sales since part of the enterprises are unprofitable, which precludes the possibility to use the indicator of net income.

Thus, the first group of companies includes: JSC "Holding company "Micron", JSC "Stankonormal" and Southern electrical company Ltd. Calculated statistical indicators of risk for these enterprises are presented in Table. 1:

Table 1

Statistical indicators of risk for the first group of companies

Year	2008	2009	2010	2011	2012
Standard deviation, thsd. UAH	18199	11897	11877	13563	19093
Coefficient of variation, %	44,6	43,4	40,3	35,2	37,7

Most scientists interpret gradation of variation coefficient as follows: 0-25% - the zone of minimal risk, 25-50% - the zone of acceptable risk, 50-75% - a critical risk zone and 75% and more - catastrophic risk zone [2, 4, 8]. With this in mind we can see that during those five years first group of enterprises was in the zone of acceptable risk.

The second group of companies includes: JSC "Odessa radial drilling machines factory", industrial association "Holodmash" and JSC "Odessa press-forging plant". Calculated statistical indicators of risk for these companies are presented in Table. 2:

Table 2

Statistical indicators of risk for the second group of companies

Year	2008	2009	2010	2011	2012
Standard deviation, thsd. UAH	4090	1152	2023	2075	4461
Coefficient of variation, %	76,0	55,4	58,3	56,1	51,7

Those calculations clearly show that the second group of enterprises belongs to the zone of critical risk during the entire five year period. That, in fact, is confirmed by financial reporting according to which the activity of the second group of enterprises is characterized not by profits, but mostly by losses.

On the third step we use the fault tree and select risks that affect operations of the enterprise. This fault tree method will directly identify internal or external risks that affect the activities of an enterprise.

The fourth step is the evaluation of internal risks of the enterprise with the help of method of financial ratios. One of the areas of statistical analysis is the development of risk assessment system of coefficients that characterize activity of the enterprise and allow us to get justified conclusions regarding the state of the whole enterprise. This method relies on the use of relative values and is based on the analysis of financial statements.

Modern science knows more than 200 relative indicators that can be calculated on the basis of the financial statements of the enterprise. However, it makes no sense to calculate them all: the main coefficients can give the necessary information.

In order to select the coefficients that are most relevant to certain activities of the company, we have examined the main approaches to the assessment of enterprises on the basis of financial indicators.

There were following selection criteria for the further analysis of the coefficients:

- Financial indicators should have the form of statistical relative values and be measured as percentage or decimal fraction;

- Coefficient should be used in most methodologies of assessing financial situation of enterprises and organizations;

- Coefficient should be calculated on the basis of the balance sheet or financial results report.

Thus, we selected such coefficient groups: indicators of property condition of the enterprise, indicators of the operational analysis, indicators of asset management, liquidity indicators, profitability indicators, gearing ratios, asset management ratios.

However, the calculation of the proposed coefficient groups itself is hardly informative. Certain conclusions can be drawn only in terms of spatial-temporal analysis and comparison of calculated values with standard ones. So the actual values of the coefficients calculated for a particular company are compared to the standard values, and the degree of deviation of the actual values from the standard ones tells us about the magnitude of risk. Moreover, various coefficients can indicate different risk levels. In this situation for each of the coefficients we have to determine the range of deviation from the norm (range of values). Just as in the statistical analysis, we propose to allocate four risk zones: zone of minimal risk (deviation within 25% from the norm), zone of acceptable risk (deviation within 50%), the critical risk zone (deviation within 75%) and catastrophic risk zone (more than 75% of deviation).

We note that for some of the selected parameters normative values are not set. In these cases it is necessary to judge about positive or negative changes in the dynamics.

In order to make the results comparative they are ranked by assigning them a certain score. We propose to assign scores to the obtained nominal values on the basis of correspondence of the received coefficient values to a certain risk zone, as well as to its value in the dynamics. So, 1 point corresponds to the indicators of zone of minimal risk, 2 points – to the zone of acceptable risk, 3 points – to the critical risk zone, 4 points – to the catastrophic risk zone. Thus having defined the group of financial indicators of risk assessment, their normative values and the area of their

oscillations we can calculate to which risk zone belongs this or that enterprise (or its subsystem).

The risk of internal subsystem of the company is calculated by the following formula:

$$R_s = \frac{\sum S_i}{n},$$

where R_s – risk of enterprise subsystem;

S_i – scoring value of the i-th coefficient in the group boundaries;

n – number of coefficients in the group.

Aggregate internal risk of the enterprise as a whole is a weighted average of the sum of all risk levels and subsystems and is defined by the following formula:

$$R_e = \frac{\sum Rsq}{m},$$

where R_e – aggregate internal risk of enterprise;

m – number of subsystems of organization;

q – specific importance of each risk group.

The results of the integrated assessment of internal risks of analyzed machine-building enterprises can be represented as follows (Table 3):

Table 3

Integral assessment of internal risk of enterprise

Enterprise	2008	2009	2010	2011	2012
JSC “Holding company “Micron”	1,9	1,6	1,5	1,5	1,4
Southern electrical company Ltd.	1,5	1,9	1,5	1,4	1,2
JSC “Stankonormal”	2,7	1,7	2,0	1,7	2,1
JSC “Odessa press-forging plant”	2,7	2,5	2,3	2,3	2,3
JSC “Odessa radial drilling machines factory”	2,6	2,2	2,1	2,3	2,3
JSC “Industrial association “Holodmash”	3,4	3,2	2,6	3,2	3,1

As it can be seen from the calculations, part of the enterprises has a minimum level of internal risks, most of the enterprises are on border between acceptable and critical risk zones, and only one enterprise is situated in the zone of critical risk (Industrial association “Holodmash”).

We have found that the greatest impact on the enterprises of industry at the micro level have financial risks. Marketing and production risks have an average level of influence.

With help of calculated indicators we also can determine position of the enterprise in the market among other enterprises of its industry. Also it is possible to assess the reliability of partners. So we propose to apply another statistical method – method of assessing latent indicators on the basis of coefficients of financial statistics.

To determine the level of riskiness of the company and its place in the market among other similar companies, we offer the use of multivariate statistical methods – namely, the methods of classical and modified taxonomy.

It is necessary to set the following tasks:

1. Setting the model (anti-model) based on the distribution of symptoms into stimulants and disincentives.
2. Calculation for each object similarity with the model (difference from anti-model) that serves as the basis for determining the rank of all the variants of riskiness of the company.

To solve the problem we used system STATISTICA and its modulus – "Cluster Analysis."

Aggregated results of the study are presented in Table. 4.

Table 4

Dynamics of internal risk of machine building enterprises of Odessa region

Enterprise	2008	2009	2010	2011	2012	Average rank score
JSC “Holding company “Micron”	1	1	1	1	1	1
Southern electrical company Ltd.	2	2	2	2	2	2
JSC “Stankonormal”	3	4	3	4	3	3
JSC “Odessa press-forging plant”	4	3	4	3	4	4
JSC “Odessa radial drilling machines factory”	5	6	5	5	5	5
JSC “Industrial association “Holodmash”	6	5	6	6	6	6

Analysis of calculations showed that the closest in its values to the model indicators (enterprise with minimal level of risk) is JSC “Holding company “Micron”, which has a maximum similarity with the model itself and ranked first during the entire period. Second place goes to Southern electrical company Ltd., the third – to JSC “Stankonormal”. Outsider is JSC “Industrial association “Holodmash”.

It should be noted that the ranks obtained by the modified algorithm of taxonomy coincide with these results.

The proposed methodology can also help to find the ways to reduce risks of the enterprises by comparing the values of symptoms of leaders and outsiders.

At the final fifth step of the proposed integrated assessment (expert risk assessment) we define the probability of realization of external risks. To do this, experts, professionals, businessmen and scientists were interviewed.

We offer the following sequence of expert assessment of external risk:

1. Identification of external risks of macro-level.
2. Ranking of risks by levels that determine the importance of each group of a certain level, i.e. the priority of each risk group.
3. Determination of the specific gravity of simple risk in all population of risks.
4. Calculation of the weight of each simple risk within the range of zero to unity.
5. Determination of weight of the lowest priority group.
6. Determination of the weight of all groups’ priorities.
7. Calculation of the weight of simple risks that are included in certain priority group.
8. Estimation of the probability of risk occurrence.

According to the results of held expert evaluation of risks accompanying external activities of enterprises we determined that the groups of administrative and legislative, market, financial and information risks are characterized by the highest probability of occurrence and the greatest degree of influence.

IV. Conclusions

1. Using the methodology described in the article we divided risk into external and internal components and calculated the total amount of risk.
2. Usage of the proposed methodology in our view will allow to take into account different industry features to quantify business risks for a particular company.
3. Thus while using the methods that we described we were able to reveal the following risks in the activity of machine-building enterprises of Odessa region: financial risks, manufacturing risks, qualification risks, information risks, administrative risks and regional risks that affect profitability of enterprise.

Prospect of further research is to reveal a more objective method to assess external risks.

Literature

1. Семенова К. Д. Обґрунтування господарських рішень та оцінювання ризиків : Навчальний посібник / К. Д. Семенова. – Одеса : ОНЕУ, ротапринт, 2013. – 194 с.
2. Семенова К. Д. Виявлення та оцінка ризиків як елемент забезпечення конкурентоспроможності підприємства / К. Д. Семенова, К. І. Тарасова // Конкурентоспроможність підприємства : оцінка рівня та напрями підвищення : [монографія / за заг. ред. О. Г. Янкового]. – Одеса : Атлант, 2013. – С. 337-352.
3. Тарасова К. І. Кількісна оцінка ризиків у підприємницькій діяльності // К. І. Тарасова // Науковий вісник. Одеський державний економічний університет. Всеукраїнська асоціація молодих науковців. – Науки: економіка, політологія, історія. – 2011. - №24(149). – С. 3-11.
4. Тарасова К. І. Методологічні засади кількісної оцінки ризиків / К. І. Тарасова // Наукові записки Національного університету «Острозька академія» серія «Економіка». – 2013. – С. 367-372.
5. Вітлінський В. В., Великоіваненко Г. І. Ризикологія в економіці та підприємництві: Монографія. — К.: КНЕУ, 2004. — 480 с.

6. Comprehensive assessment of risk / К. І. Тарасова // Міжнародна науково-практична конференція «Економічні механізми стимулювання соціально-економічного розвитку» : Тез. Доп. – м. Ужгород, 2013 р. – С. 137-140.
7. Старостіна А.О. Ризик-менеджмент: теорія та практика: Навчальний посібник / А.О. Старостіна, В.А. Кравченко. – К. : ІВЦ «Видавництво «Політехніка», 2004 – 200с.
8. Вишняков Я.Д. Общая теория рисков : учеб. пособие для студ. Высш. учебных заведений / Я.Д. Вишняков, Н.Н. Радаев. – М. : Издательский центр «Академия», 2007. – 368 с.
9. Погорєлова Т. В. Статистичні методи оцінювання фінансової діяльності підприємств та організацій / Т. В. Погорєлова // Вісник соціально-економічних досліджень: зб. наук. пр. / ред. М. І. Звєряков; Одеський держ. екон. ун-т. – Одеса, 2007. – Вип. 25. – С. 276-282.
10. Підгорний А. З. Теорія статистики: навчальний посібник / А. З. Підгорний. – Одеса, 2001. – 140 с.
11. Підгорний А. З. Статистика: навчальний посібник / А. З. Підгорний, І. Г. Готліб, К. В. Вітковська [та інші] / за ред.. А.З.Підгорного. - Одеса, 2013. – 106 с.
12. Самотоєнкова О. В. Економічна статистика: навчальний посібник / О. В. Самотоєнкова, Ю. О. Ольвінська. - Одеса: ОДЕУ, 2010. – 182 с.