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Classification of Large and Socially Important Enterprises of the Region by the Levels of Their Economic Solvency

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Abstract: The article solves the task of classification/grouping of the regional enterprises based on the sampling of large and socially important enterprises; the number of classes/groups of enterprises by the levels of economic solvency; and other parameters. The discriminant analysis is provided for differentiation (discrimination) of the observed objects by certain attributes and the tasks of classification with learning are solved. The levels of absolute, relative and conditional economic solvency are identified.

Key words: Region · Economic solvency · Enterprise · Sampling

INTRODUCTION

Large and socially important enterprises (LCIP) are the cornerstone of the economy of a region. They form its strategic relations, while acting as the dominant factor of the regional development. Analysis of economic solvency of large and socially important enterprises helps to determine the key directions in the process of solving the problems of the strategy of regional economy management.

The classification of regional enterprises by the levels of economic solvency is interesting in terms of the problems of analysis of the financial and economic state of a separate enterprise. At the same time, the regional aspect of the classification tasks solution is also very important. Its peculiarities lead to the total of large strategic enterprises of a region, which is based on the industrial, interindustrial and regional principles. The goals of solving such classification tasks, as a rule, are related to the analysis of microeconomical factors of the region development and the improvement of the efficiency of the regional economy management.

In the complex of tasks of classification analysis of economic solvency of large and socially important enterprises of the region, the ones of special importance are: determination of the number and the structure of classification levels and sublevels of solvency; formation of the system of indexes of the economic solvency evaluation; analysis of the ratios between groups of enterprises, which belong to different levels of solvency and especially stable ratios; analysis of the morphological and functional structures of classes of the enterprises' solvency.

RESULTS

An important peculiarity at setting these goals is the existence of traditional understanding of the classification levels. The levels of absolute, relative and conditional economic solvency are distinguished. The classification levels are described as follows: absolute economic solvency - an enterprise is in the state of absolute equilibrium by all of the components of the evaluation in accordance with all criteria; relative economic solvency - an enterprise successfully conducts its business, has certain difficulties and overcomes them through the usage of the mechanisms of adaptation; conditional economic solvency - there are some deep-rooted breaches of the most important parameters of all functional components of the solvency.

Thus, statement of the task of classification/grouping of regional enterprises is based on the following parameters: sampling of large and socially important enterprises; the number of classes/groups of enterprises by levels of economic solvency; the systems of classification attributes, which are the indexes of the enterprises' performance with account of the regional economy's specificity; the characteristics of the distinguishing features of each class by the preset package of attributes.

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The result of the task solution is identification of the level of economic solvency, to which the large and socially important enterprises of the region belong to and the formation of groups of enterprises, which belong to certain types of solvency, based on it.

The distinguishing feature of the existing methods of evaluation of the level of economic solvency is that they use the approach, which assumes assigning of classification attributes in the form of the system of summary indexes. The main part of the indexes provides a high quality evaluation of the components of the market, production and financial solvency of an enterprise, e.g. "sound production potential", "stability of the market share", "critical financial position" and others. The summary statements on the solvency of enterprises are made based on the determination of the attributes' values and their informal logic consolidation.

Such approach generates a number of classification problems, among which the most notable ones are: the large relative share of expert estimations, fulfilled within the analysis of certain indicators, consolidated indexes and for the enterprise as a whole, i.e. commitment to expert opinion. This, in particular, significantly increases the level of subjectivity of the received results, often conditioning the polemical character of the conclusions; the comparability of the individual indexes of solvency. Determination of proportions between all individual indexes, between individual indexes and the summary indexes that consolidate them. Determination of the significance unit of measurement, the "weight" of the index; classification of enterprises, which relate to the transitional levels of evaluation, e.g. the intermediate one between the relative and conditional solvency; the large scopes of sampling at providing the enterprises' analysis within the given region. In case of large and socially important enterprises, it includes several hundreds of objects described with dozens of indicators. As for the comparative analysis of the whole system of enterprises of the region, the scopes of sampling can reach dozens of thousands observations (e.g. in the Republic of Tatarstan, there are over 81 thousand economic entities).

Development of the method of classification of enterprises of a region by levels of economic solvency targeted the improvement of the existing approaches. This task was carried out by the following directions:

- Usage of the methods of intellectual data mining, which allowed gaining unbiased results from the perspective of both the procedures and the formal criteria of the results' quality evaluation, as well as to solve the problems of classification at transitional levels of solvency.
- Usage of the set of individual and aggregate quantitative indicators of solvency. Abandonment of qualitative evaluations in their function as the parameters of the tasks being solved.
- Decrease of the scope of expert estimation of the initial state of enterprises and the results of the solution of the classification tasks with correct combination of expert estimates, the structure of quantitative indicators and formal classification procedures.
- Increase of the level of the task solution processibility with account of the necessity to gain results on the given samplings from a large scope.

As the basis for the solution of classification tasks, the methods of discriminant analysis (DA) were chosen, which have been developed to an extent sufficient for solution of practical problems. They are provided in several articles [1, 2].

The goal of the discriminant analysis is the solution of tasks of differentiation (discrimination) of the objects of observation by certain attributes. This type of analysis is applied for approaching the tasks of classification with learning.

Methods of the discriminant analysis are broken up into to independent groups. The first one allows determining significant differences between the existing classes according to the preassigned training sampling; the second one allows providing classification of new objects of a class, which has been unknown before.

The procedure of the solution of a task of classification of the regional LCIP by the levels of economic solvency includes several stages:

Preparation of the Statistical Population Data: The source data containing information on the analyzed enterprises are consolidated in a summary table, which contains:

- Data identifying the enterprise. Normally, their names and OKPO, OKVED and other codes are included.
- Evaluation indicators - the discriminant variables. Values of indicators are determined for all enterprises of the analyzed sampling.
- Auxiliary analytic indexes. These are set for the singled out subpopulation or for all enterprises. These are used for approaching tasks of evaluating

the economic solvency, which do not belong to the group of classification tasks. They allow providing an in-depth statistical analysis of the singled out groups of enterprises by the levels of solvency.

Methods of discriminant analysis produce certain requirements to the size and the structure of the preassigned statistical population [1], which must be essentially taken into account at assigning and approaching the tasks of enterprises' classification. They, at least, include requirements of normal allocation of the discriminant variables, homogeneity of the variance-covariance matrix, absence of completely excessive discriminant variables and so on.

By approaching the classification tasks, the situation offers occurs, when those enterprises are included in the same statistical population, which are obviously incommensurable with the tenfold and hundredfold difference in the indicator values. Thus, some extreme sources of values appear in it, which strongly increase the extent of the data changeability. Such enterprises are reasonable to exclude from the population and allocate by the classes based on the solution of a standalone task.

Preparation of Training Samples: Formation of a training sample is the most complex and critical stage of the task solution. Usually, a training sample is formed in stages based on arrangement of an iterative solution of a task. Each iteration includes analyzing the received results and taking a decision on updating the quantitative parameters of the training data with account of the experts' opinions.

The main practical problems of the preparation of a training sample are:

- Existence of complex and to some extent contradictive requirements for the structure of the training sample for a certain level of enterprises' solvency.
- Correct comparison of values of the training variables with the value of the dependent variable being the attribute of the level of solvency (of a group of enterprises). It resides in the absence of inconsistent, mutually exclusive values of the discriminant variables, which describe the same group.
- Determination of the due scope of sampling.

For approaching these problems in the context of the assigned task, it is necessary to follow two main principles of the preparation of a training sample:

- Determination of a training sample based on the settled general theoretical and practical views, i.e. stating the samples of the solvency levels.
- Determination of a training sample based on the actual data describing enterprises, which are the standard ones for the stated levels of solvency. The value of the dependent variable for them is known before the task is solved and the belonging to a certain class is determined by expertise.

If providing classification by S levels is required, it is necessary to introduce at least $2.S$ observations in the training sample, which would include the parameters of the top and bottom margins of values, at which the objects are assigned to the respective levels. Such a case rather rarely generates correct results. Usually, additional observations, which state values within the gradations' margins, are included in training samples. If necessary, such cases are accounted, when a certain level of solvency must include the enterprises, with the values of indexes beyond the margins of respective gradations.

The scope of a training sample cannot be too small (in practice, it is between 6 and 10 observations) and it should not be too large, as the solution of the classification task will lose its significance. Our practical experience in solving the classification tasks by the levels of solvency confirms that the due quality of results can be achieved with the training sample equal to 3-5% of the total scope.

In any case, the formation of a training sample is the main chain link of the expert part of the task solution. Thus, expert reports on the levels of enterprises' solvency are focused on the preliminary stage of the solution and allow determining the parameters of the levels.

Solution of the Task and Analysis of the Results: The main results of the enterprises' classification task solution is the determination of the calculated or forecast values of the dependent variable of discriminant analysis, which describes the level of solvency/a group of enterprises as well as the parameters of the probabilities of the enterprises' inclusion into the predetermined groups.

If the training sample has been compiled properly, the predetermined and forecast values of the dependent variable in it are equal. In practice, there may be some deviation, which does not affect the quality of the results. If there are no significant deviations between the predetermined and forecast values combined with the high degree of statistic reliability of the results, the solution of the task can be treated as formally completed.

Receiving final results after the first approach to the solution of a task is not common. Usually, there are either a lot of conflicts between the predetermined and forecast classes/groups in the training sample, or enterprises, the formal assignment of which to a certain level of solvency is doubted in terms of economic criteria. Such situation is the consequence of the defective determination of the training sample, caused by its incorrectness from the mathematical point of view or by the defects of the economic evaluation. It results in the necessity to change the given sampling in order to account the purposes of the analysis by way of updating and expanding the stated information, which requires additional expert evaluation. After the training sample has been changed, the task solution is repeated again until correct results are received.

The considered method was used for solution of a package of tasks on classification of large and socially important enterprises of the Republic of Tatarstan by the levels of economic solvency. The economic aspect of the task assignment was mainly determined by its dependence on the main provisions of the system of indicative management, which exists in the republic.

The tasks statement included three classes/groups of enterprises by levels of economic solvency - those with absolute, relative and conditional solvency, without determination of sublevels of the latter.

The original statistic sampling included the data on more than 200 large and socially important enterprises of Tatarstan. The study of the structure of the source total shows its industry-related representativeness, particularly, inclusion in the sampling of enterprises of approximately 20 main branches of the republic's economy.

One of the main issues of the decision preparation was the selection of financial and economic indexes, which would appropriately describe the level of economic solvency of the economic entities of the region. At the selection, the provisions of the theory of economic solvency were taken into account as well as the experience in solving similar tasks for the republican enterprises during the previous few years. The indexes of the current liquidity ratio, the capital ratio, the solvency ratio, the added value per one employee, the average salary and other indexes played special role in the structure of the evaluative indicators, which determine the discriminant variables.

CONCLUSIONS

Two tasks were solved using the considered method:

- The task of comparative evaluation of the economic solvency of enterprises based on the developed set of evaluation indexes.
- The task of comparative evaluation of the economic solvency based on the existing standards of indicative management of the enterprises in the republic.

The first task was approached in dynamics for a series of years. At setting the marginal values of the levels of solvency for the predetermined evaluation indexes, both the international and Russian experience of evaluation and the results of expert examination of the enterprises' solvency and theoretical standard marginal values were taken into account.

At the solution of the second task, the marginal levels of solvency for the values of evaluation indexes were formed based on the percentage of the standard index of indicative management.

Index of indicative management	Level of economic solvency		
	Absolute	Relative	Conditional
Percentage of completion	Above 85%	60 – 85%	Below 60%

The results of the task solution show that approximately 35% of the total number of enterprises in the region is absolutely economically solvent, 6% are relatively solvent, 18% are conditionally solvent and 41% are conditionally insolvent.

The list of enterprises with absolute economic solvency includes virtually all enterprises of the electric energy and fuel industry as well as petrochemical enterprises and some enterprises of the engineering and metal-processing industries. The results of the analysis show that *the most important for the economy of the region enterprises are absolutely solvent.*

And the group of conditionally insolvent enterprises includes the enterprises of the agricultural, food and consumer industries, as well as the majority of enterprises of the construction materials sector. The enterprises of this group are in a difficult situation due to the lack of working capital, strong wear of technological equipment, decrease of profitability caused by the cost increase and price control by manufacturers and the weak competitive position of their products.

For the analyzed region, the nonlinear dependence was determined between the current liquidity ratio (L) and the balance of the account receivables and account payables (c) with respect to the revenues [3]:

$$L(c) = Ae^{-\frac{(c-B)^2}{D}}$$

where A is the marginal regional standard of liquidity in the circumstances of the existing balance of indebtedness of enterprises in the region;

B – is the value describing the reserve of stability of the enterprises with respect to the indebtedness;
D – is the ratio indicating the influence of secondary factors (e.g., sector profile) on the liquidity of enterprises.

For the system of large and socially important enterprises of the Republic of Tatarstan, the following values of the function parameters were obtained: A = 1.886, B = 0.238 и D = 0.432.

The value of the stability reserve of large and socially important enterprises of the region (***R***) was determined as $R = \int_0^B L(c)dc$. It equals to approximately 0.41 for the analyzed region. This value can be interpreted as the relative share of enterprises, which keep their liquidity due to the accounts receivable from other enterprises in the region.

The results of the analysis show that the formation of enterprises of regional importance in the Republic of Tatarstan has mostly finished. This includes over 20 enterprises of the oil and gas sector, energy sector, engineering and food industries. The large and socially important enterprises represent a stable regional economic system.

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