METHODOLOGY FOR MULTICRITERION ASSESSMENT OF IMPACT OF FACTORS ON FINANCIAL SUSTAINABILTY OF FIRMS OPERATING IN VARIOUS SECTORS OF ECONOMY

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Considering a nature of sector characteristics, a new method is proposed that is based on multicriterion assessment of selection of alternatives in ambiguous situations and that allows to formulate and perform various tasks on increasing financial sustainability of firms and taking decisions about the current state and development prospects of enterprises, namely: (1) analysis and assessment of significance of criteria of financial sustainability and their ranking by significance, (2) assessment and selection of limited number of factor groups affecting financial sustainability of enterprises as well as ranking them by level of impact in such a manner that would meet the requirement of each criterion, (3) econometric analysis, short-, medium-, and long-term forecasting of key figures and indicators of financial state of enterprises and assessing the degree of meeting liabilities.

Keywords: financial stability, financial coefficients, liquidity, profitability, creditworthiness, ranking of financial criteria

Introduction: The process of analysis and measurement of financial stability in enterprises belonging to various economic sectors is established by a multi-criteria comparison of variables under a large number of contributing factors [3,6,7]. The decision making process in such uncertain conditions on the selection of one or more factors influencing financial stability of enterprises and their ranking, satisfying all the criteria under the conditions of sustainable financial stability, is a quite complicated task [2,8,6,9]. For this reason a systematic approach is adopted which selects one or more factors that influence financial stability of enterprises of various economic sectors and their ranking depending on the degree of influence of each respective factor.

Enterprise Financial Assessment Criteria

In the analysis of financial conditions of enterprises belonging to different economic sectors a set of criteria is used, which in the financial economic literature is called the set of coefficients of financial assessment [3,6,7]. Those can be separated in four groups:

1. Solvency, which characterizes the ability to repay one's long-run liabilities. For the analysis of solvency the following criteria are being often used:

–Solvency coefficient;

–Coefficient of the proportion of long-run liabilities to private capital stock.

2. Liquidity - it's used to measure the ability of an enterprise to fulfill its short-term liabilities and characterizes the satisfactory extent of coverage of short-term liabilities with short-term assets, which correlate in terms of the maturity of expected closure of the liability. The analysis of liquidity is performed mainly through the usage of the following criteria:

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–Liquidity ratio;

–Temporary liquidity coefficient;

–Absolute liquidity coefficient.

3. Creditworthiness, which characterizes the ability to repay credit in a timely manner, including the interest and other components, is usually measured by the following criteria:

–Coefficient of fulfillment of interest payments;

–The ratio of cash flow to liabilities.

4. Profitability, which characterizes the ability of the enterprise to generate profits, satisfying the necessary prosperity of the firm, and how effective the enterprise's performance really is. Usually, the following criteria are used to measure profitability:

–Profitability of sales;

–Profitability of assets.

Financial measurements make it easier to detect special tendencies in the development of the enterprises, which are much harder to identify if using just the absolute measures.

None of the criteria presented above provide enough information on the basis of which it would be possible to derive a definite conclusion on the financial condition of an enterprise. This becomes possible only after the analysis of the whole set of coefficients.

As mentioned before, the analyzed criteria are used quite frequently. In the financial economic literature, there exist other coefficients, and it's always possible to create and work with additional ones. In fact, the quantity of financial coefficients is large and it continues to increase with the progressing research efforts on financial measurement. However, development of new coefficients may not only overcomplicate the analysis but bring a certain degree of unnecessary uncertainty.

Factors, influencing the financial condition of enterprises

Financial measures, if they are correctly interpreted, are a very important analytical instrument, especially in the comparison of projects in the research on the revitalization of enterprises in the various sectors of the economy. Including, but not limited to, increasing revenues which is necessary for the fulfillment of obligations and for the prosperity of the enterprise itself. Decision making on the financial stability of the enterprise of different sectors of the economy must be carried out with the identification of a set of independent factors, which in turn influence the financial condition of the enterprise. In general, we can attribute the following [6]:

Objective factors:

–Changing natural conditions;

–Active tax obligations;

–Condition of main assets, etc.

Conditionally-subjective factors:

– Overdue liabilities;

– Lack of material assets to acquire materials and technical resources for the performance of enterprise activities;

– Price changes;

– Expected inflation;

– Degree of automation of production processes;

– Introduction of new powers into exploitation, etc.

In such scenario it's important to select one or a set of factors, which influence

financial stability of enterprises in the various sectors of the economy and their ranking based on existing criteria. As discussed above, there are many such criteria, and the probability of an event that some factor will be more favorable according to all criteria is minimal and even unknown. It's considered that the decision making process of the selection of one or more factors which influence the financial instability of enterprises of various economic sectors and their raking must be based upon the usage of these analytical criteria of financial stability. Universality of a method which would more or less optimize all such criteria doesn't exist.

To that end, it's necessary to create a method which would allow to correctly measure and select one or more such factors in a multi-criteria framework, and also rank them according to respective importance and influence. This problem can be solved with help of a decision making framework that includes multiple quotients and expert measurements [1,2,5,8,9].

Measurement of influence of various factors on the financial condition of enterprises

Assume that as a result of analysis of financial conditions of enterprises of various sectors of the economy, a set $S^k, k = 1,..., K$ (here, K - quantity of sectors in the economy) is chosen which influences their financial stability:

$$U^k = \left\{ u_i^k : i = 1,2,..., S^k \right\} \quad (1)$$

and a quantity from L criteria among the existing criteria of financial measurement, with the help of which a choice of one or more factor groups, which influence financial stability of the enterprises of various economic sectors, is made:

$$V = \left\{ v_j : \ j = 1,2,..., L \right\} \quad (2)$$

The problem consist of the fact that one must choose one of the factors $u_{i^*}^k, k = 1,..., K$ or rank them according the defined criteria $n_j, j = 1,..., L$.

The mathematical logic of the coefficients $s_j, j = 1,..., L$ means that the bigger the value of s_j, the more important the criteria n_j which is satisfied by the following condition:

$$s_j \geq 0 \qquad \text{and} \qquad \frac{1}{L} \sum_{j=1}^{L} s_j = 1 \quad (3)$$

Notably, coefficients regarding the importance of $s_j, j = 1,..., L$ can be determined by applying one of the famous methods of expert assessment. The traditional approach to solving the problems of choice in such conditions consists in the procedure, which LPR (or a group of experts) with help of dual comparisons establish between criteria some inconclusive relationships of the form:

– "Criterion K_i is more important than K_j";

– "Criterion K_i is significantly more important than K_s", etc.

Imprecise ratios of the analyzed types are usually reflected in a collection of real numbers (in particular, on the number and sub-number of real numbers), called the scale of measurement. In many methods of dual comparisons as a scale of measurement the Saati [8,9] scale is used, according to which the imprecise relations of the type "equal", "better", or "more important", etc. are measured according to the following table (for brevity, comparison and measurement of relationships between projects and relationships between certain criteria are united in a single table).

Scales of Measurements

Relationships between criteria n_i, n_j	Grades
n_i and n_j are equally important	1
n_i somewhat more important than n_j	3
n_i more important than n_j	5
n_i considerably more important thann_j	7
n_i significantly more important than n_j	9
For the temporary measurements LPR	2,4,6,8

With help of the usage of the given table we first create the matrix of partnered comparisons: $R = \|r_{t,l}\|$, elements of which are determined from the table and satisfy the following conditions:

$$r_{t,t} = 1;\ r_{t,l} = 1/r_{l,t},\ t,l = 1,2,...,L \tag{4}$$

After this, according to [2,5], it's necessary to find the R matrix vector $X = (x_1, x_2,..., x_L)$, which corresponds to the maximum value of $l_{\max.}$

By definition of finding the matrix vectors $\Lambda = (l_1, l_2,..., l_L)$, it's evident that their quantity is equal to L. During the determination of the degree of expert opinion, we determine the maximum self value of matrix R.

$$l_{\max} = \max_{j\in\{1,...,L\}} l_j \tag{5}$$

We note that it's always the case that $l_{\max} \geq L$ and here the deviation of $l_{\max}$ from L may act as a degree of agreeability between the expert opinion during the measurement of the relative importance of the criteria, i.e. the difference $l_{\max} - L$ is characterized by the measure of agreeability of opinion between experts under the grading of the relative importance of criteria $n_j, j = 1,...,L$ based on the given table and points at the occasion when the experts must be checked. According the system of linear equations regarding the variables $x_j, j = 1,...,L$, achieved from the formula $RX = l_{\max} X$ and the conditions of normalization, the subjective vector X of matrix R is determined under the maximum value [2,5]. Based on the above assumptions, we can propose the following methods of choice of subjective vectors for the non-ideal matrix of comparisons (here we don't differentiate vector-row from vector-column):

$$x_j = 1 \Big/ \sum_{k=1}^{L} r_{kj},\ j = 1,...,L, \tag{6}$$

$$x_j = \sum_{x=1}^{L} r_{jx} \Big/ \sum_{k=1}^{L}\sum_{x=1}^{L} r_{kx},\ j = 1,...,L \tag{7}$$

$$x_j = \frac{1}{L}\sum_{x=1}^{L} \frac{r_{jx}}{\sum_{k=1}^{L} r_{kx}},\ j = 1,...,L, \tag{8}$$

Coefficients of interest of the importance of s_j are determined by the multiplication of elements of subjective vectors X, which correspond to the maximum value of $l_{\max}$, on L, and satisfy the following conditions:

$$s_j = L \cdot x_j \tag{9}$$

Now, we proceed with the realization of the multi-criteria procedures of choice of or more factors, influencing the financial stability of enterprises on the basis of indefinite values. To this end, we present the criterion V as an indefinite quantity in the following manner [1,2]:

$$V = \left\{ m_v(u_i^k) / u_i^k : i = 1,..., S^k, k = 1,..., K \right\} \tag{10}$$

where $m_v(u_i^k) \in [0,1]$ is a measure of factor u_i^k on the criterion V, which characterizes the degree of correspondence and the function of the belongingness of the vector.

Since the criterion v_j has a heterogeneous relative importance s_j, imprecise relationships, presented in formula (10), take on the following form:

$$v_j^{s_j} = \left\{ m_{v_j}^{s_j}(u_i^k) / u_i^k : i = 1,..., S^k, k = 1,..., K \right\}, j = 1,..., L. \tag{11}$$

According to the theory of indefinite values, if there exists L criteria: $x_1, x_2, ..., x_L$, then the best factor is considered that factor among the set of U, which satisfies both the criterion v_1, and criterion v_2,…, and v_L. Then, the rule of choice of the best influential factor can be written in the form of the intersection of the corresponding indefinite values, presented in formula (11) [1]:

$$D = \prod_{j=1}^{L} v_j^{s_j} \tag{12}$$

It's known that the operation of intersections of indefinite values corresponds to the operation *min*, performed over the following functions:

$$m_D(u_i^k) = \min_{j \in \{1,..., L\}} m_{v_j}(u_i^k), \quad i = 1,...S^k, k = 1,..., K \tag{13}$$

The best factor among $u_{i*}^k, k = 1,..., K$ is selected as the one which has the highest value of the function of belonging $m_D(u_i^k), i = 1,..., S^k, k = 1,..., K$, i.e.:

$$m_D(u_{i*}^k) = \max_{i \in \{1,..., S\}} m_D(u_i^k), k = 1,..., K \tag{14}$$

This way, the described measure can make it possible to select the most influential factor, depending on the value of the dependency function, and also rank it according to the respective degree of importance.

Conclusions

We have proposed a method which allows to perform a multi-criteria analysis and choice of one or more amounts of factors that influence financial stability of enterprises, and the method also ranks them according to their respective influence, satisfying the demands of each analytical criterion of financial stability, which in turn reflect the specifics of various sectors of the economy. The proposed method makes it possible to conduct a systematic research analysis of the financial condition of enterprises, determination of key factors influencing the financial situation of those enterprises, finding their degree level, performance of the methods of revenue increase, which eventually positively affects the financial sustainability of enterprises in the various sectors of the economy.

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