Methodology for Assessing the Economic Sustainability of Chemical Enterprises

Kadirov Abdumalik Matkarimovich
Ph.D, Researcher at the Tashkent State University of Economics
abdumalik.kadirov@list.ru

Abstract. **In this article, the author proposes a theoretical analysis of aspects of the methodology for assessing the economic sustainability of industrial enterprises, analyzes the positions of the authors on the topic of economic sustainability of an industrial enterprise, and also studies the conceptual apparatus of "economic sustainability" and methods for assessing the economic sustainability of industrial enterprises. As a result of the study, we have given our own concept of "economic sustainability", and also analyzed the methods for assessing the economic sustainability of different authors. The author has developed an innovative model for assessing the economic sustainability of industrial enterprises based on the method of integrated differential equations with the transformation of individual factors in relation to the sum of factors, using coefficient methods of financial indicators of an industrial enterprise, taking into account the factors of the components that show the level of influence on the economic sustainability of an industrial enterprise. The model was tested on the example of industrial enterprises of the Republic of Uzbekistan. The model has shown its effectiveness, it can be used in calculating the assessment of the economic efficiency of industrial enterprises.**

Keywords: Economic stability, integrated indicator, financial stability, weight coefficients, industrial enterprise, microenvironment, internal and external factors.

1. INTRODUCTION

The chemical industry has been struggling to conduct sustainable operations within safe planetary limits, while being socially sound and profitable. Industrial systems are composed of complex arrangements that can vary from system's boundary, production phase, management level and sustainability dimensions. The integration of such concepts is essential for sustainable development. Another crucial point is the procedure for unbiased decision-making. Contrarily to past works that separately address these concepts, this work integrates all aspects under a system's perspective.

Economic sustainability of the cellulosic ethanol production processes is assessed based on both the micro- and macro-economic aspects. The micro-economic aspects include the capital cost, operating cost, as well as overall profitability, while macro-economic aspects include value-added investments and taxes. It can also be estimated by the total annual costing of each process configuration per quantity of ethanol produced [25].

2. LITERATURE REVIEW

The article considers four models for assessing the economic sustainability of different authors: the model of M.G. Efimova - shows the levels of factors affecting economic sustainability. Model for assessing economic sustainability authors V.V. Volkov, T.A. Khudyakova "An integrated approach to determining the indicator of economic sustainability based on weight coefficients". An interesting approach is V.A. Tulueva to assess the economic sustainability of the enterprise. The author develops a model based on integral criteria. We also considered the model of N.A. Lvova, which reflects all aspects of financial stability and as a parallel to economic stability. As a result, we have developed an innovative methodology for assessing economic sustainability based on the method of integrated differential equations with the transformation of individual factors in relation to the sum of factors, using coefficient methods of financial indicators of an industrial enterprise, taking into account the factors of the components that show the level of impact on the economic sustainability of an industrial enterprise. An innovative method for assessing economic sustainability based on the method of integrated differential equations of industrial enterprises shows how much these factors affect the financial performance of an industrial enterprise, that is: if the impact is low, then it is necessary to optimize this factor by developing measures to improve it.

The importance and relevance of the economic analysis of the microenvironment of industrial enterprises is, today, the main elements of the functioning, work of industrial enterprises. Their sustainable, stable economic and financial activities are the key to the well-being of the entire financial, economic, social system of the state. The economic environment, the stability of industrial enterprises provides competitive economic and financial ties, the stability of economic relations both in the domestic market and internationally, important components of the economic sustainability of an industrial enterprise are factors influencing the financial and production capabilities of industrial enterprises.

We note the main factors that affect the sustainable financial and economic condition of industrial enterprises: production capabilities, technological and technical component, resource saving, resource component, organizational component, personnel and intellectual components, investment component, financial component, management component, institutional and legislative component, infrastructure, consumer component, intermediary component (suppliers, contractors, etc.), etc. That is, we see a huge number of factors that directly affect economic sustainability in the course of an industrial enterprise. In this paper, we will explore precisely the economic (financial) sustainability of industrial enterprises, we note that economic sustainability is a heterogeneous concept, it has a multi-criteria and multi-factor functioning system. In this case, it would be appropriate to consider the definition of the concepts of "economic sustainability" and the methodology of economic sustainability of various authors who directly contributed to the economic discipline: Agafonkina N.V.[1], Zolotov D.G., Kovalev P.N., Belkin D.V.[2], Budovich L.S.[3], Volkov V.V.[4], Khudyakova T.A., Vygodsky M.Ya.[5], Gnatyuk S.N.[6] , Pushkina L.I., Efimova M.G.[7], Korsunova O.V.[8], Kuznetsova E.I., Laptev D.N.[10], Lvova N.A. [11], L. G. Milyaeva [12], A. V. Minakov, L. N. Ivanova [13], Ya. R. Mikhailov. [14], Ovodkov D.A. [16], Papekhin R.S. [17], Prokofieva E.V. [18], Semenov A.A. [19], Sigitova N.N. [20], Tulueva V.A. [21], Shekshuev A.V. [22], Sigitova N.N., Tulueva V.A., Ana C.S. Mendes [23], Fernando A.F. Ferreira, Devika Kannan, Neuza Q.F. Ferreira Ricardo, J.C. Correia., Chitra Lekha Karmaker [24], Ridwan Al Aziz, Tanmoy Palit, A. B. M. Mainul Bari and others.

3. ANALYSIS AND RESULTS

When developing a model, it is necessary to take into account a set of factors that affect economic sustainability, to study objects as systems consisting of interdependent elements. To do this, we will draw up a block diagram of the influence of factors on the economic stability of industrial enterprises.

Financial stability shows the solvency of an industrial enterprise, its financial capabilities, its own sources of financing.

Next, we present a coefficient method for calculating the financial stability and profitability of an industrial enterprise:

$$CR = \frac{\text{ЧП}}{\text{Д}}, \quad (1)$$

CR – profitability of an industrial enterprise, %;

ЧП – net profit of the enterprise;

Д – enterprise profitability.

Next, we present the calculation of the financial stability of an industrial enterprise:

$$\text{СФУ} = \frac{(\text{СС}-\text{ДолЗС})}{\text{ВБ}}, \quad (2)$$

СФУ – financial stability of an industrial enterprise, %;

СС – own funds of the enterprise;

ДолЗС – long-term borrowed funds of the enterprise;

ВБ – balance currency.

Note that we will calculate these coefficients for each enterprise when testing the developed model.

Next, we present an algorithm for calculating economic sustainability, taking into account the factorial criteria and coefficients that we considered earlier, for this we use mathematical tools, the basis of which will be the method of integrated differential equations, for this we apply the following equation:

$y' = f(x, y)$ under initial conditions: $x = x_0$ and $y = y_0$.

Thus, let's imagine a series where the factors $c_1, c_2, c_3, c_4, \ldots c_n$ will be presented as coefficient criteria for financial indicators, $x_1, x_2, x_3, x_4 \ldots x_n$ will be presented as factors that influence the economic sustainability of industrial enterprises [5] .

The row will look like this:

$$y = y_0 + c_1(x - x_1) + c_2(x - x_2)^2 + c_3(x - x_3)^3 + c_4(x - x_4)^4 + \ldots + c_n(x - x_n)^n, \quad (3)$$

In this case, we transform the equation as follows, for each factor it is necessary to calculate its level in relation to the sum of factors, we get the following variation, which as a result will show the percentage criterion for assessing economic sustainability:

$$y = y_0 + c_1\frac{(x - x_1)}{\sum_{n=1}^{1} x} + c_2\frac{(x - x_2)^2}{\sum_{n=2}^{2} x} + c_3\frac{(x - x_3)^3}{\sum_{n=3}^{3} x} + c_4\frac{(x - x_4)^4}{\sum_{n=4}^{4} x} + \ldots + c_n\frac{(x-x_n)^n}{\sum_{n=n+1}^{n} x} = y_0 \ldots + c_n\frac{(x-x_n)^n}{\sum_{n=n+1}^{n} x}, \quad (4)$$

For each individual factor, the equation will look like this:

$$y_1 = c_1 \frac{(x - x_1)}{\sum_{n=1}^{1} x}$$
$$y_2 = c_2 \frac{(x - x_2)}{\sum_{n=2}^{2} x}$$
$$y_3 = c_3 \frac{(x - x_3)}{\sum_{n=3}^{3} x}$$
$$y_4 = c_4 \frac{(x - x_4)}{\sum_{n=4}^{4} x}$$
$$y_n = c_n \frac{(x - x_n)}{\sum_{n=n+1}^{n} x}$$

That is, we arrive at a system of equations:

$$\begin{cases} y_1 = c_1 * x_1 \\ y_2 = c_2 * x_2 \\ y_3 = c_3 * x_3, \\ y_4 = c_4 * x_4 \\ y_n = c_n * x_n \end{cases} \quad (5)$$

Having transformed the system of equations, a model is obtained that shows an estimate of economic efficiency:

$$ЭФ_n = \sum_{n=1+1n}^{n} c_n * x_n = y_1 * y_2 * y_3 * y_4 * \dots * y_n, \quad (6)$$

Table 1: Economic sustainability assessment levels

Levels	**Grade**
Tall	From 25 and above
Above average	15 to 25
Middle	5 to 15
Short	0.5 to 5
Critical	Below 0.5

Thus, we have obtained a model for assessing the economic sustainability of industrial enterprises, which will be measured according to the developed scale (Table 1).

The high level of economic sustainability of industrial enterprises testifies to the positive influence of factors of both external and internal environment, as well as the high production and financial potential of the enterprise, high financial stability and high profitability of production.

An above average level of economic stability will indicate a favorable production potential of an industrial enterprise, a positive influence of certain factors, a good profitability of production, and positive financial stability.

The average level of economic stability of industrial enterprises indicates a satisfactory state of the enterprise, a positive and at the same time negative influence of some factors, in this situation, problem areas of the enterprise will be identified, namely factors that negatively affect the enterprise, and to which management should pay due attention to eliminate imperfections, also the average level will indicate a low financial stability and profitability of the enterprise.

A low level of economic stability will indicate low profitability, low financial stability, as well as unsatisfactory financial and production potential of the enterprise, and this level also shows the negative impact of many factors on the potential of an industrial enterprise.

The critical level of economic stability will indicate the bankruptcy of the enterprise, that is, negative profitability, the increase in external financing of the enterprise, that is, complete dependence on external creditors, as well as the low level of own sources of financing, which are not enough to pay obligations and debts.

Thus, this model can be used to calculate the economic sustainability of industrial enterprises. This model has its advantages and disadvantages.

Disadvantages of the developed model:

- the model can be applied only when factor indicators are taken into account;
- time-consuming calculation, taking into account large data of factor indicators.

Model advantages:

- the model shows the level of influence of factors on the production and financial capabilities of an industrial enterprise;

- the model identifies problem areas in the enterprise, namely the negative impact of some factors that need to be paid attention to and appropriate measures should be taken;
- when calculating the economic sustainability of an industrial enterprise, the profitability and financial sustainability of production are taken into account, which shows the degree of benefit received from the manufactured products.

4. CONCLUSION

Thus, we have developed an innovative methodology for assessing economic sustainability based on the method of integrated differential equations with the transformation of individual factors in relation to the sum of factors, using coefficient methods for the financial performance of an industrial enterprise, taking into account the factors of the components that show the level of impact on the economic sustainability of an industrial enterprise. An innovative method for assessing economic sustainability based on the method of integrated differential equations of industrial enterprises shows how much these factors affect the financial performance of an industrial enterprise, that is: if the impact is low, then it is necessary to optimize this factor by developing measures to improve it. For example, the demand for industrial products can be optimized through marketing strategies, pricing, contractual terms, and so on. If the influence of the factor is average, then it is also necessary to take measures to optimize some processes that reduce the assessment of economic sustainability; sustainability of an industrial enterprise. Next, we will test the developed model on the example of industrial enterprises of the Republic of Uzbekistan.

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