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[https://doi.org/10.60022/sis.1.\(01\).2](https://doi.org/10.60022/sis.1.(01).2)

MODELLING THE IMPACT OF FACTORS ON THE PROFITABILITY OF BUSINESS ENTITIES ACTIVITY

Abstract. *The instability of the market environment requires business entities to make timely management decisions in order to ensure an appropriate level of profitability of production activity. At present, there are a significant number of methodologies that allow evaluating profitability and forecasting its dynamics for any period in the best possible way. Simultaneously, there is a need to deepen the modelling of the influence of factors that change the profitability of production, which is especially important in the context that profitability is a complex index. That is why accounting of its components will allow identifying the impulses that lead to a decrease or increase in the profitability of an entrepreneurial entity activity.*

The materials for the study are officially promulgated statistical data on the financial activity of business entities, including large, medium, small and micro-enterprises. The assessment of the impact on the level of profitability of all activities of enterprises is carried out with the involvement of factors: the volume of sales, capital investment, the number of employees, labour productivity, labour costs, the value of current assets, and the value of non-current assets. The information base for the evaluation is the data for the retrospective period of 2010–2020. In the process of modelling, we used such methods: analysis, synthesis, induction and deduction, as well as a set of statistical techniques for calculating the correlation coefficient, Student's t-test and Fisher's criteria, regression analysis, coefficient of determination, etc.

The results of the implementation of the proposed methodology of calculating the impact of individual factors of economic activity on the resulting indicator of profitability have revealed the dependence between the main indicators and profitability. In particular, the following results are obtained: for large enterprises the dependence between the profitability of operating activities and all factors is significant; for medium enterprises, the dependence between the profitability of operating activities and the volume of products sold and the volume of capital investment is revealed; for small enterprises, the dependence is found only on the volume of capital investment. Moreover, for microenterprises, the dependence of profitability on individual factors of economic activity was not detected. For all enterprises, the dependence of profitability of operating activity on the volume of products sold, the volume of capital investment, labour productivity and labour costs was revealed. The proposed methodology for modelling the impact of individual indicators on the profitability of business entities has made it possible to identify the impulses that should be addressed to prevent the bankruptcy of an enterprise or a reduction in its profitability. The methodology will be useful for interested stakeholders wishing to systematically monitor profitability and make adequate management decisions on this basis.

Keywords: *modelling, economic activity, business entities, profitability, investment, labour productivity, current and non-current assets, products sold, employment, remuneration.*



1. Introduction

Entrepreneurs are constantly feeling the pressure of the external environment. An unstable market environment, economic changes, and the transition to an innovation-oriented business model require a stable financial state for enterprises. In such a case, the maintenance of an appropriate level of profitability is an important condition for effective business activity. Profitability is not a personified indicator. It consists of a system of factors that influence the bottom line in various ways. This is why there is a need for more in-depth research into modelling the impact on the profitability of individual indicators of economic activity. It is advisable to forecast profitability in order to form future strategies for enterprise development. The mentioned above stipulates the importance of our further research on the selected topic of the article.

The purpose of this article is to model the assessment of the impact of business activity indicators on the profitability of enterprises.

The problematic of modelling the impact of individual activity indicators on profitability has been investigated in the works of many scholars. Louis *et al.*, [1], give an example of calculating the financial independence of institutions and directions of increasing their profitability. The authors have paid special attention to achieving the social efficiency of an institution, which is profitable and in demand on the market. Using financial data from 650 institutions, the authors proposed a “self-organisation map” methodology, where they evaluated profitability, financial performance and social effectiveness, and determined the interdependence between them.

Tenge and Hella [2], investigated the costs, financial attractiveness and resulting profitability of implementing a range of soil and water conservation measures in agricultural production on the steep slopes of the Western Usambara Mountains. The researchers dynamically assessed the costs of introducing conservation measures and gave short- and long-term results of improving the profitability of agriculture while conserving natural resources through moderate investment in smallholder labour. The authors present a system of indicators, which allow the best possible analysis of the cause-and-effect relationships of changes in the profitability of production.

Chen *et al.*, [3], investigate the effects of the privatisation of Chinese state-owned companies and the impact of the free market on their operations. The study carefully assessed the operational efficiency of privatised enterprises over the past five years. Using a system of indicators, including those for calculating profitability, the researchers identified the reasons for the decline in profitability and assets, and compared the resulting financial results with enterprises in other countries that have also been privatised. The authors found that the profitability of privatised enterprises increases when private investors have too

much control over the firm. The authors conclude by stressing that only a complete relinquishment of control by the state over private businesses can improve the financial performance of a business.

Quite unconventional, but interesting for our study are the scientific conclusions of Luo, [4]. The researcher assessed the profitability of large banks. The study was particularly focused on market efficiency. The paper used a nonparametric marginal method of data analysis, with a sample of 245 large banks. The author performed calculations on the profitability of large banks, which allowed him to draw certain conclusions. In particular, the results indicate that the geographical location of banks does not affect efficiency. Finally, the overall technical efficiency of profitability characteristics can predict the possibility of bank failures. The scholar has refuted the existing hypothesis in the academic world that geographic location and the resource potential of individual territories have no significant impact on banking efficiency. However, banks located in unfavourable geographical locations should be given special attention by the government.

Enqvist *et al.*, [5], calculated the impact of working capital management on the profitability of Finnish firms in different business cycles. The authors estimated the impact of business cycles on working capital — profitability. The data of registered Finnish companies for an 18-year period served as analytical materials. The methodology proposed in the article revealed that the impact of the business cycle on working capital and profitability ratios is more pronounced during economic downturns than booms. Researchers have proved the importance of effective management and planning of reserves, profitability and receivables during economic downturns.

Olson and Zoubi, [6] modelled the profitability assessment of banks in ten countries in the Middle East and North Africa. Using accounting-based efficiency characteristics of banks, they investigated the efficiency of costs and profits. Researchers have proved that there is a need to focus more on profit efficiency than on cost efficiency. In the paper, the researchers proposed a number of approaches to measuring profitability and calculating the impact of individual indicators on profitability.

Significant scientific findings for our study are the findings of Aissa and Goaied, [7] who gave an example of calculating the profitability of Tunisian hotels and assessing managerial efficiency. The authors proved that hotel management efficiency is a determinant for profit generation, which depends on hotel size, debt, investment, location, stage of the business cycle and the international attractiveness of the area for tourists. The article provides an example of the calculation of the profitability of the assets of 27 hotel companies operating in Tunisia. An interesting finding in the article is the authors' view that the education of hotel managers has an impact on hotel profitability.

Syriopoulos *et al.*, [8] provide an example of calculating profitability in the cruise industry. It is undeniable that the cruise industry is recovering from the financial crisis of 2008, as shown by the steady growth in its profitability over the decades. The same cannot be said for commercial shipping. That is why leading cruise companies are implementing ambitious investment plans to expand and renew their ship fleet with large, modern, high-class ships that would meet the most demanding needs of consumers. The researchers in the article propose for the first time a methodology for assessing the impact of investment on the financial performance of large cruise companies. The methodology is useful to the tourism industry because it allows it to calculate the profitability of a cruise company as quickly as possible and to suggest ways of increasing its profitability by attracting investments.

Significant within the scope of our study are the research findings of Le *et al.*, [9]. In the paper, the authors show trends of financial inclusion in Asia and assess its impact on financial efficiency and sustainability. The assessment was carried out using a sample of data from 31 Asian countries for the period of 2004–2016. The estimation methodology proposed by the authors is rather unconventional, as constructed using principal component analysis, based on normalised variables. By testing the methodology, the authors found that trends in financial inclusion vary from country to country, but in some cases, there is no dependence on financial stability. Using the method of least squares, the authors prove that an increase in financial inclusion has a negative effect on financial efficiency but a favourable effect on financial stability.

Le and Ngo propose an interstate comparison of profitability in their article. [10]. In particular, using data on bank profitability in 23 countries from 2002 to 2016 period, the researchers used the to calculate how the number of bank cards issued, ATMs and terminal points can improve bank profitability. Among other results, the authors proved the negative impact of government on bank profitability caused by excessive government intervention in the banking sector.

Eling and Jia, [11] analysed the relationship between firm performance and profitability using the accounts of over 5,000 insurance companies. The authors demonstrated a significant positive correlation between efficiency and profitability. In addition, the researchers proved a significant industry dependence of the profitability of life insurance companies with respect to others.

The topic of profitability and digitalisation is raised in their article by Veltri *et al.*, [12], who review existing methodologies for assessing the profitability of financial institutions and propose their own method for determining the impact of individual enterprise activity indicators on profitability. A similarly themed article by Campanella *et al.*,

[13], where the authors rightly point out that digital transformation has led to a multifaceted shift in the financial industry. This is why there is a need to investigate the impact of digital transformation on profitability and the quality of human capital in the European banking system. Using data from 1,250 banks in the European Union, the authors prove that the banking sector is undergoing a transformation of its traditional business model, which in turn leads to increased efficiency and profitability.

Notes the risk factor in the process of realisation of business activity Biellialov, [14], who proposes an innovative toolkit to activate the start-up movement through the modernization of the process of promoting innovative products in the market in the form of start-ups. In the article, the author uses simulation and structural-functional modelling methods to determine the potential market demand for innovative products and planning their promotion in the market. In addition, the author proposes a methodology for assessing the economic efficiency of managing the process of promoting innovative products in the market, which can be useful in the framework of our research.

Zhivko *et al.*, [15], propose to test the efficiency of enterprises to use the Saati scale adapted for this purpose, in which, based on the decomposition of a complex problem, the authors calculated the security efficiency of managerial accounting and defined its dependence on the management decisions taken. Some of the authors' ideas and scientific conclusions are appropriate for implementation in our research.

The study by Tiutiunyk *et al.*, [16] where the authors developed a model for estimating the relationship between the level of shadow economy and social development indicators of the country is noteworthy. The modelling methods proposed by the authors, as well as approaches to assessing the relationship between the level of the shadow economy and social development indicators of the country, are appropriate to use for our study.

The analysis of scientific works of scientists proves their high relevance for modelling the profitability assessment of business entities. However, given the current trends in the turbulent market environment, these studies are severely lacking, which makes our research relevant, timely and important.

2. Materials and Methods

We propose to assess the impact on the level of profitability of all activities of enterprises involving the following factors:

- the volume of products sold;
- capital investments;
- the number of employed workers;
- labour productivity;
- labour costs;
- the value of current assets;
- the value of non-current assets.

The assessment will be carried out for all enterprises and separately for large, medium, small and micro enterprises.

Information base for assessment is data for the retrospective period 2010–2020.

Let us introduce a notation:

Y — is the profitability of all company activity;

X_1 — volume of products sold;

X_2 — amount of capital investment;

X_3 — number of employed workers;

X_4 — labour productivity.

X_5 — labour costs;

X_6 — value of current assets;

X_7 — value of non-current assets

The relationship between the level of profitability and the factors affecting it will be assessed by means of correlation coefficients:

$$r_i = \frac{\sum_{t=1}^T (x_i(t) - \bar{x}_i)(y(t) - \bar{y})}{\sqrt{\sum_{t=1}^T (x_i(t) - \bar{x}_i)^2 \sum_{t=1}^T (y(t) - \bar{y})^2}}, \quad (1)$$

where r_i — is the correlation coefficient between Y and X_i indicators;

T — is the length of the retrospective period ($T = 11$);

t — is the order number of the year in the retrospective period;

$x_i(t)$, $y(t)$ — the value of X_i , and Y in year t ;

$\bar{x}_i$, $\bar{y}$ — the average values of these indicators during the retrospective period.

Check the significance of the calculated correlation coefficients using Student's t-test criteria. The correlation coefficient is considered significant if the empirical value of Student's t-test criteria does not exceed its critical value. The empirical values are calculated according to the formula

$$t_i = \frac{r_i^i}{\sqrt{1 - (r_i^i)^2}} \sqrt{T - 2}, \quad (2)$$

and the critical value $t(\alpha, k)$ is defined by confidence probability α and number of degrees of freedom $k = T - 2 = 9$. Assuming confidence probability $\alpha = 0.9$, we obtain $t_{kp}(\alpha, k) = 1.833$. The values of the correlation coefficients between the indicator of the profitability of all enterprises activity and X_i indicators, and the corresponding empirical values of the Student's t-test criteria are given in Table 1.

Thus, a correlation has been established between the profitability of all enterprise activity and the volume of investments. This relationship holds for all enterprises and separately for large, small and medium enterprises. No correlation between profitability and the volume of investment was found for microenterprises. A correlation between profitability and the volume of sales was found for large, medium, small and micro enterprises. For small enterprises and microenterprises, a relationship was found between profitability and wage costs, and for

microenterprises, in addition, a relationship between profitability and labour productivity.

For the above dependencies we write a pairwise linear regression equation $Y = a_i X_i + b_i$. The coefficients of this equation are determined from the system of equations:

$$\begin{cases} a_i \sum_t x_i^2(t) + b_i \sum_t x_i(t) = \sum_t x_i(t) y(t) \\ a_i \sum_t x_i(t) + b_i T = \sum_t y(t) \end{cases}. \quad (3)$$

To assess the adequacy of the obtained regression equation to the actual data, we use Fisher's criteria. For this purpose, we determine the coefficient of determination by the formula:

$$R_i^2 = 1 - \frac{\sum_{t=1}^T (y(t) - a_i t - b_i)^2}{\sum_{t=1}^T (y(t) - \bar{y})^2}. \quad (4)$$

According to Fisher's criteria, a regression equation is considered to be adequate to the actual data if the empirical value of these criteria exceeds the critical value. The empirical value of Fisher's criteria is determined from the equality:

$$F_i = \frac{R_i^2}{1 - R_i^2} (T - 2), \quad (5)$$

and the critical value $F(\alpha, k_1, k_2)$ is determined by the confidence probability α and the number of degrees of freedom $k_1 = 1$, $k_2 = T - 2 = 9$. Taking probability $\alpha = 0.9$, we obtain $F(\alpha, k_1, k_2) = 3.36$.

3. Results and Discussion

The obtained coefficients a_i and b_i of the regression equations, determination coefficients, empirical values of Fisher's criteria and conclusions concerning the adequacy of the regression equations to the initial data for all identified correlation relationships between profitability of all activities and the factors affecting it are given in Table 2.

The resulting regression equations can be used to predict the expected level of profitability under various changes in the factors affecting it. To obtain the predicted value of Y_p , profitability substitute into the regression equation the value of the factor included in the model in the future period of time. Nevertheless, under the influence of many other factors the real value of profitability may differ significantly from the obtained forecast. This is why it is necessary to determine the interval $[Y^{\min}, Y^{\max}]$, to which future profitability value will relate with a certain probability. To do this, we determine a value Δ equal to half the length of this interval, using the formula:

$$\Delta = \sqrt{\frac{1}{T} + \frac{(X_i^p - \bar{x}_i)^2}{\sum_{t=1}^T (x_i(t) - \bar{x}_i)^2}} t(\alpha, k) S, \quad (6)$$

where X_i^p — predicted value of the indicator X_i , T — is the duration of the retrospective period, $x_i(t)$ is the value of X_i in the t year of this period, $\bar{x}_i$ — is the average value of this quantity, $t(\alpha, k)$ is the critical

Table 1

Correlation coefficients between the profitability indicator of the whole enterprise activity and the factors affecting it, and the corresponding values of the Student's t-test criteria

Indicator	Correlation coefficient	Student's t-test criteria	Conclusion on the existence of a connection
All enterprises			
X_1	0,516827	1,811121	Not detected
X_2	0,628371	2,423292	Detected
X_3	0,138378	0,419167	Not detected
X_4	0,461186	1,559284	Not detected
X_5	0,501351	1,738299	Not detected
X_6	0,238936	0,738189	Not detected
X_7	0,139167	0,421604	Not detected
Large enterprises			
X_1	0,5337	1,893283	Detected
X_2	0,543655	1,943224	Detected
X_3	-0,12963	-0,3922	Not detected
X_4	0,469957	1,597245	Not detected
X_5	0,48213	1,650942	Not detected
X_6	0,23188	0,715131	Not detected
X_7	0,193873	0,592868	Not detected
Medium enterprises			
X_1	0,531971	1,884723	Detected
X_2	0,639992	2,498727	Detected
X_3	0,368972	1,190949	Not detected
X_4	0,453586	1,526861	Not detected
X_5	0,511953	1,787934	Not detected
X_6	0,243678	0,753755	Not detected
X_7	0,126528	0,382659	Not detected
Small enterprises			
X_1	0,5518	1,984948	Detected
X_2	0,646836	2,544498	Detected
X_3	0,111035	0,335178	Not detected
X_4	0,49277	1,698895	Not detected
X_5	0,565552	2,057269	Detected
X_6	0,322477	1,022031	Not detected
X_7	0,139852	0,42372	Not detected
Micro-enterprises			
X_1	0,592456	2,206258	Detected
X_2	0,345404	1,104169	Not detected
X_3	0,11365	0,343173	Not detected
X_4	0,55451	1,99901	Detected
X_5	0,604588	2,277058	Detected
X_6	0,365017	1,176208	Not detected
X_7	0,100102	0,301822	Not detected

Source: calculated by the authors

value of Student's t-test's criteria, S is the square root of the variance of adequacy defined by equality

$$S^2 = \frac{\sum_{t=1}^T (y(t) - a_i x_i(t) - b_i)^2}{T - 2}. \quad (7)$$

With the probability α given by determining the critical value of the Student's t-test's criteria, the predicted profitability value will belong to the

interval $[Y_p - \Delta, Y_p + \Delta]$. Let us define the interval predictions under the assumption that the factors that have a significant effect on profitability, i.e., the volume of sales (X_1), the volume of capital investments (X_2), labour productivity (X_4) and labour costs (X_5) remain at the level of 2020. We take the probability α to be 0.9. The results of the study are shown in Table 3.

Table 2

Regression equation coefficients, coefficients of determination and empirical values of Fisher's criteria

Type of enterprises	Indicator X_i	Coefficients of the regression equation		R^2	Fisher's criteria	Conclusion
		a_i	b_i			
All	X_2	0,000000029	-8,547505	0,39485	5,87234	Adequate
Large	X_1	0,000003338	-7,383774	0,28484	3,58453	Adequate
Large	X_2	0,000000049	-5,747348	0,29556	3,77611	Adequate
Medium	X_1	0,000002572	-6,050535	0,28299	3,55217	Adequate
Medium	X_2	0,000000069	-6,966824	0,40959	6,24365	Adequate
Small	X_1	0,000008635	-14,855599	0,30448	3,94001	Adequate
Small	X_2	0,000000243	-17,143194	0,41840	6,47448	Adequate
Small	X_5	0,000000064	4,897785	0,31985	4,23236	Adequate
Micro	X_1	0,000034714	-25,028064	0,35100	4,86757	Adequate
Micro	X_4	0,022937257	-23,799046	0,30748	3,99605	Adequate
Micro	X_5	0,000000576	-24,515530	0,36553	5,18500	Adequate

Source: calculated by the authors

Table 3

Projected profitability of all activities at 2020 factor values level

Enterprises	Factor	Factors' value	Lower limit of profitability	Upper limit of profitability
All	X_2	398478079,00	2,631	3,131
Large	X_1	3626388,00	4,388	5,054
Large	X_2	190109186,00	3,321	3,857
Medium	X_1	4359362,10	4,800	5,523
Medium	X_2	163690967,00	4,132	4,649
Small	X_1	2064120,70	2,366	3,571
Small	X_2	44677926,00	-6,589	-6,025
Small	X_5	137136910,40	3,543	4,847
Micro	X_1	704885,60	-1,330	0,213
Micro	X_4	976,70	-2,187	-0,605
Micro	X_5	45013716,80	0,549	2,248

Source: calculated by the authors

Table 4

Elasticity coefficients

Enterprises	Factor	Elasticity coefficient
All	X_2	3,96687
Large	X_1	2,56402
Large	X_2	2,60129
Medium	X_1	2,17222
Medium	X_2	2,58681
Small	X_1	6,00470
Small	X_5	4,32537
Micro	X_5	18,52463

Source: calculated by the authors

Thus, small enterprises are assumed to be unprofitable with investment at the 2020 level and microenterprises are unprofitable with labour productivity and sales volumes unchanged from 2020. Calculations based on the corresponding regression equations show. That profitability requires a 65%

increase in investment for small enterprises and a 20% increase in labour productivity and 10% increase in sales for microenterprises.

Define the elasticity coefficients, which show by how much the profitability will increase if the factor influencing it increases by 1%, while the other

factors remain unchanged. The elasticity coefficients are determined from the following equation

$$Kel_i = \frac{a_i x_i(t)}{a_i x_i(t) + b_i} \quad (8)$$

The elasticity coefficients are determined for $t = T$. i.e. for 2020. The results of the calculations are shown in Table 4.

Let us investigate the impact of factors on the profitability of operating activity of enterprises with a breakdown into large, medium, small and micro enterprises. To do this, we determine the correlation coefficients between the profitability of operating activity and indicators X_i , for each type of enterprises and check their significance by Student's t-test criteria. The results of the study are presented in Table 5.

Table 5

Correlation coefficients between the profitability of operations activity indicator of enterprises and the factors affecting it

Indicator	Coloration coefficient	Student's t-test criteria	Conclusion on the existence of a connection
All enterprises			
X_1	0,621096	2,377450	Detected
X_2	0,704709	2,979759	Detected
X_3	-0,096275	-0,290173	Not detected
X_4	0,594593	2,218556	Detected
X_5	0,571942	2,091719	Detected
X_6	0,408023	1,340752	Not detected
X_7	0,314969	0,995579	Not detected
Large enterprises			
X_1	0,785791	3,811482	Detected
X_2	0,698848	2,931120	Detected
X_3	-0,573221	-2,098684	Detected
X_4	0,773934	3,666387	Detected
X_5	0,681906	2,796839	Detected
X_6	0,626777	2,413159	Detected
X_7	0,616195	2,347131	Detected
Medium enterprises			
X_1	0,550541	1,978445	Detected
X_2	0,666428	2,681553	Detected
X_3	0,255718	0,793538	Not detected
X_4	0,495808	1,712769	Not detected
X_5	0,506549	1,762498	Not detected
X_6	0,283608	0,887254	Not detected
X_7	0,149138	0,452476	Not detected
Small enterprises			
X_1	0,492110	1,695890	Not detected
X_2	0,633869	2,458632	Detected
X_3	0,106304	0,320731	Not detected
X_4	0,442081	1,478574	Not detected
X_5	0,487716	1,675997	Not detected
X_6	0,305074	0,961035	Not detected
X_7	0,103023	0,310724	Not detected
Microenterprises			
X_1	0,486924	1,672425	Not detected
X_2	0,356597	1,145070	Not detected
X_3	0,125059	0,378144	Not detected
X_4	0,455015	1,532926	Not detected
X_5	0,490235	1,687381	Not detected
X_6	0,313933	0,991946	Not detected
X_7	0,031988	0,096014	Not detected

Source: calculated by the authors

Comparing the correlation coefficients between profitability of all activities and X_i indicators, with the correlation coefficients between profitability of operating activity and the same indicators, we see that there is a clear difference in the correlation between these coefficients for different types of companies. For large firms, all of these correlation coefficients for profitability of operating activity are higher in absolute value than those for profitability of all activities. For small firms, the coefficients for profitability of all activities are higher. For medium enterprises, the correlation coefficients for profitability of operating activity are higher than all X_i indicators, except the number of employees and labour costs. For microenterprises, the correlation coefficients for profitability of all activities are higher for all indicators except for the amount of capital investment and the number of employees. For all enterprises, the correlation coefficients for profitability of operating activity exceed in absolute value the similar coefficients for profitability of all activities for all indicators X_i , except the number of employees.

For large enterprises, a significant correlation between the profitability of operating activity and all indicators X_i was found. For medium-sized enterprises, a correlation between the profitability of operating activity and the volume of products sold, and the volume of capital investment was found, for small enterprises only on the volume of capital investment, and for microenterprises, no correlation dependence was detected. For all enterprises, a correlation was found between profitability of operating activity and the volume of products sold, the volume of capital investment, labour productivity and labour costs.

For the significant relationships identified, let us write a pairwise linear regression equation $Y_1 = a_i X_i + b_i$, where Y_1 — is profitability of operations.

The obtained coefficients a_i and b_i , of the regression equations, determination coefficients, empirical values of Fisher's criteria and conclusions concerning the adequacy of the regression equations to the initial data for all identified correlation dependences between the profitability of operating activity and the factors affecting them are given in Table 6.

The resulting regression equations can be used to predict the expected level of operating profitability under various changes in the factors affecting it. The results of the study are shown in Table 7.

Thus, small enterprises are assumed to be unprofitable at the 2020 level of investment. A calculation based on the relevant regression equation shows that a 55% increase in investment is required for small enterprises to achieve operating profitability.

4. Conclusions

Thus, we propose modelling the assessment of the impact of certain factors on the level of profitability of business entities, namely: the volume of products sold; capital investment; the number of employees; labour productivity; labour costs; the value of current assets; the value of non-current assets. Using a complex of statistical methods for the calculation of a correlation coefficient, Student's t-test and Fisher's criteria, regression analysis, determination ratio and others, we have developed the forecasting modelling of the expected level of profitability at various changes of the factors influencing it. Practical implementation of the simulation was carried out on the example of small, medium,

Table 6

Regression equation coefficients, coefficients of determination and empirical values of Fisher's criteria for profitability of operating activity

Type of enterprise	X_i indicator	Coefficients of the regression equation		R^2	Fisher's criteria	Conclusion
		a_i	b_i			
All	X_1	0,000000878	-0,71049628	0,38576	5,65227	Adequate
All	X_2	0,000000022	-1,203554	0,49662	8,87896	Adequate
All	X_4	0,006847007	-0,002710	0,35354	4,92199	Adequate
All	X_5	0,000000010	0,804856	0,32712	4,37529	Adequate
Large	X_1	0,000002930	-0,477195	0,61747	14,52739	Adequate
Large	X_2	0,000000038	1,674486	0,48839	8,59147	Adequate
Large	X_3	-0,004495520	15,276760	0,32858	4,40448	Adequate
Large	X_4	0,003568211	1,719096	0,59897	13,44239	Adequate
Large	X_5	0,000000029	1,728047	0,46500	7,82231	Adequate
Large	X_6	0,000000003	3,542770	0,39285	5,82333	Adequate
Large	X_7	0,000000002	3,726670	0,37970	5,50903	Adequate
Medium	X_1	0,000001831	-0,033129	0,30310	3,91424	Adequate
Medium	X_2	0,000000050	-0,718988	0,44413	7,19073	Adequate
Small	X_2	0,000000085	4,638637	0,40179	6,04487	Adequate

Source: calculated by the authors

Table 7

**Projected values of profitability of operating activity with the values
of factors at the level of 2020**

Enterprises	Factor	Value of the factor	Lower limit of profitability	Upper limit of profitability	Elasticity coefficient
All	X ₁	11062297,10	8,757	9,250	1,07892
All	X ₂	398478079,00	7,330	7,639	1,16080
All	X ₄	1238,52	8,242	8,713	1,00032
All	X ₅	398478079,00	7,407	7,706	1,25151
Large	X ₁	3626388,00	10,003	10,294	1,04702
Large	X ₂	190109186,00	8,694	8,966	0,81036
Large	X ₃	1574,60	8,052	8,344	-0,86345
Large	X ₄	2303,05	2,679	2,910	0,82700
Large	X ₅	299116348,40	10,333	10,746	0,83604
Large	X ₆	2061443982,40	8,673	8,988	0,59882
Large	X ₇	2577268195,10	8,440	8,742	0,56620
Medium	X ₁	4359362,10	7,703	8,193	1,00417
Medium	X ₂	163690967,00	7,243	7,588	1,09696
Small	X ₂	44677926,00	-4,773	-4,270	-2,06366

Source: calculated by the authors

large and micro-enterprises. The results show that, for large enterprises, there is a significant relationship between the profitability of operating activity and all factors. For medium-sized enterprises, the dependence of profitability of operating activity on the volume of products sold and the volume of capital investment is found, while for small enterprises — only on the volume of capital investment. No

dependence was found for microenterprises. For all enterprises, the dependence of profitability of operating activity on the volume of products sold, the volume of capital investment, labour productivity and labour costs was found. Our further research will focus on the search for the reserves necessary to increase the profitability of business entities activity.

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Received: 5/01/2023

Accepted: 14/03/2023

Published: 29/12/2023

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[https://doi.org/10.60022/sis.1.\(01\).2](https://doi.org/10.60022/sis.1.(01).2)

МОДЕЛЮВАННЯ ВПЛИВУ ФАКТОРІВ НА РЕНТАБЕЛЬНІСТЬ ГОСПОДАРСЬКОЇ ДІЯЛЬНОСТІ СУБ'ЄКТІВ ПІДПРИЄМНИЦТВА

Анотація. Нестабільність ринкового середовища вимагає від суб'єктів підприємницької діяльності прийняття вчасних управлінських рішень з метою забезпечення належного рівня рентабельності виробничої діяльності. На цей час існує значна кількість методик, які дозволяють у найліпші способи здійснювати оцінку рентабельності та прогнозувати її динаміку на будь-який період. Одночасно існує потреба поглиблення моделювання впливу чинників, які змінюють рентабельність виробництва, що особливо важливо в контексті того, що рентабельність є комплексним показником. Саме тому урахування його складових дозволить виявити імпульси, що призводять до зниження або підвищення прибутковості суб'єкта підприємницької діяльності.

Матеріалом для дослідження є офіційно оприлюднені статистичні дані щодо фінансової діяльності суб'єктів підприємництва, зокрема великих, середніх, малих та мікропідприємств. Оцінювання впливу на рівень рентабельності всієї діяльності підприємств здійснено із залученням чинників: обсягів реалізованої продукції, капітальних інвестицій, кількості зайнятих працівників, продуктивності праці, витрат на оплату праці, величини оборотних активів, величини необоротних активів. Інформаційною базою оцінювання є дані за ретроспективний період 2010–2020 роки. В процесі моделювання використовувалися методи: аналізу, синтезу, індукції, дедукції, а також комплекс статистичних методик щодо розрахунку коефіцієнту кореляції, критерію Стюдента та Фішера, регресійного аналізу, коефіцієнту детермінації тощо.

Результати впровадження запропонованої методики розрахунку впливу окремих чинників господарської діяльності на результуючий показник рентабельності дозволили виявити залежність між основними показниками та рентабельністю. Зокрема отримано такі результати: для великих підприємств виявлена істотна залежність між рентабельністю операційної діяльності та всіма чинниками; для середніх підприємств виявлена залежність рентабельності операційної діяльності від обсягів реалізованої продукції та обсягів капітальних інвестицій; для малих підприємств залежність виявлено лише від обсягів капітальних інвестицій. При чому, для мікропідприємств залежності рентабельності від окремих чинників господарської діяльності не виявлені. Для всіх підприємств виявлена залежність рентабельності операційної діяльності від обсягів реалізованої продукції, обсягів капітальних інвестицій, продуктивності праці та витрат на оплату праці.

Запропонована методика моделювання оцінювання впливу окремих показників на рентабельність суб'єктів підприємницької діяльності дозволила виявити імпульси, на які слід звернути увагу для недопущення банкрутства підприємства або зниження його прибутковості. Методика буде корисною для зацікавлених стейкхолдерів, які бажають систематично здійснювати моніторинг рентабельності та на цій основі приймати адекватні управлінські рішення.

Ключові слова: моделювання, господарська діяльність, суб'єкти підприємництва, рентабельність, інвестиції, продуктивність праці, оборотні та необоротні активи, реалізована продукція, зайнятість, оплата праці.