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REGRESSION ANALYSIS OF OPERATING PROFIT OF THE COMPANY

ABSTRACT

The purpose of the article is the further development of methodological provisions for economic analysis of the efficiency of use of tangible working resources and their impact on the final results of the enterprise. The theoretical and methodological basis of the study are the scientific works of foreign and domestic scientists on selected issues. In the course of the research general scientific methods of analysis, synthesis, comparison and generalization of scientific information were used. In addition, the methods of multifactor correlation-regression analysis and deterministic factor analysis were used in writing the work. A mathematical model is proposed, which allowed to assess the degree of influence on the results of operating activities of the enterprise such factors as: the share of tangible current resources in the structure of current assets; turnover ratio of material working capital; the share of working capital in tangible working capital; indicator of profitability of tangible current resources. It is estimated that 85% of the variation of the selected performance indicator is due to variation of the selected factors. A factor analysis of the efficiency of use of tangible working resources was also carried out and the economic effect obtained from accelerating the turnover of tangible working resources was calculated. Theoretical, methodical and organizational bases of the regression analysis of influence of level of use of material circulating resources on size of operating profit of the enterprise have received further development. For the first time, a mathematical model was proposed, which allowed to assess the degree of influence on the operating results of the enterprise of such factors as: the share of tangible current resources in the structure of current assets; turnover ratio of material working capital; the share of working capital in tangible working capital; indicator of profitability of tangible current resources. The practical value of scientific research is that the proposed analytical support of the process of managing the operational activities of the enterprise can increase the efficiency of providing analytical information in the time management system on existing and potential opportunities to improve the efficiency of working capital as one of the main factors influencing operational results. to achieve all financial participants of their financial goals.

Keywords: material current resources, financial result from operating activities, regression equations, factor analysis

JEL Classification: M21, M40, M49

INTRODUCTION

Information support of economic phenomena and processes today is a prerequisite for the development of effective management strategy, which is the basis for improving the efficiency of all economic activities without exception. In the context of growing demands for economic information, it is important to highlight and clearly differentiate the individual components of the information environment. For forestry, this issue is actualized due to the peculiarities of forest management, the length of the production cycle, which complicates the objective reflection of business operations in the formation and use of forest assets.

The basis of life and development of society is the production of material goods, because the products created by various sectors of the economy are a source of meeting the needs of both individual citizens and the economy as a whole. At the same time, a necessary condition for the development of the production process is its stable supply

of material current resources. This is primarily due to the fact that in the process of consumption of material working capital is transformed into material costs, which occupy the largest share in the production costs of economic entities of most economic activities.

Thus, according to the State Statistics Service of Ukraine [1], the share of material costs and costs of services used in production, in general in 2017 was 75%, in 2018 – 74.3%, in 2019 – 71.4 % and in 2020 – 73.7%. Despite a slight decrease in this indicator, for most types of economic activity its value exceeds 50% and only for such types of economic activity as education; health care and social assistance; arts, sports, entertainment and recreation – ranges from 28% to 50%.

However, as noted by S. Voloshyna [2], «today Ukraine consumes much more fuel, electricity and metal per unit of national income than developed countries, which leads to a shortage of resources due to large production volumes and the need for additional costs to increase raw materials and fuel and energy base». It is clear that such a situation causes an overestimation of the cost of production and, accordingly, can lead to a loss of competitiveness in foreign markets.

Obviously, the economical and rational use of material resources is an important reserve for maximizing the final product, financial results from operating activities and improving the efficiency of the enterprise as a whole.

Therefore, to ensure efficient and coordinated operation of the enterprise, there is a growing need to analyze the impact of the level of formation and efficiency of material current resources on the financial results of operating activities, the results of which is one of the main sources of information for management decisions on planning, monitoring, control, development of strategies and tactics of behavior in the market, improvement of equipment, technology and organization of production.

It is clear that the financial results of operating activities of the enterprise, in addition to tangible working resources, are influenced by many other factors, respectively, it is difficult to reflect the relationship between performance and the level of use of tangible working resources, because only a set of factors in their relationship can to give a more or less complete idea of the nature of the phenomenon under study.

This determines the feasibility of creating a mathematical model based on methods of multifactor correlation-regression analysis, which will assess the degree of impact on the studied performance indicator (results of operating activities of the enterprise) of each of the factors introduced into the model. position at the average level of other factors.

LITERATURE REVIEW AND PROBLEM STATEMENT

Both domestic and foreign researchers were engaged in research of problematic issues on the regression analysis of the activity of economic entities, in particular, the material resources of the enterprise. Azerbaijani authors G. Akbulaev, G. Mirzayeva [3] consider the analysis of a paired regression model of the impact of income from international tourism. Ukrainian researchers K. Bahrii and S. Luchyk [4] evaluate the use of correlation-regression analysis in assessing the solvency of the entity. Slovak scientists K. Valaskova, T. Kliestik and M. Kovacova [5] study the management of financial risks in Slovak enterprises using regression analysis. Domestic author S. Voloshyna [2] introduces an economic mechanism for managing the efficiency of use of material resources of the enterprise. The team of scientists M. Gonzalez, J. Idrobo and R. Tabora [6] use meta-regression analysis to analyze family firms and their financial performance. O. Hryhorevska [7] conducts a correlation analysis of production costs of industrial enterprises. M. Danilin and V. Klochkov [8] analyze the market of strategic resources, raw materials and components of high-tech products. Japanese and Indonesian authors H. Kamahara, M. Faisal, U. Hasanudin, K. Fujie, H. Daimon [9] analyze the material flow to manage resources for elastic production of palm oil. The team of Indian scientists D. Kumar, A. Satish and S. Asadi [10] offers an integrated analytical analysis to assess the management of material resources in the construction industry. K. Lopatka [11] considers mathematical modeling as a method of studying the factors influencing the economic security of the enterprise. A. Talakh and V. Talakh [12] determine the features of multifactor analysis of material resources of the enterprise. Ukrainian researchers A. Tyzhnenko and Y. Ryznyk [13] analyze the adequacy of solutions of the linear regression problem. American authors C. Flatt and R. Jacobs [14] highlights the basic assumptions of regression analysis: testing, methods and statistical reporting of imperfect datasets. A. Tsatsulin and O. Evreinov [15] analyzes a hybrid model of multidimensional index analysis of current assets. Chinese scientists X. Jiang and Z. Tian [16] analyze the factors influencing the sustainable use of material resources of the pulp industry. However, it should be noted that these analysts do not single out working capital as a separate object of analysis. Without reducing the contribution of scientists to the development of theory and methodology of economic analysis of material resources, given the growing importance of tangible working resources in enterprises and the need for timely management information, it should be noted that the general methodology of analysis of material resources does not always synthesize the main financial results of the enterprise. Therefore, there is a need to improve

the methodological provisions for economic analysis of the level of influence of the state and efficiency of material current resources on the financial results of operating activities of the enterprise, taking into account the methods of multifactor analysis.

The purpose of the article is the further development of methodological provisions for economic analysis of the efficiency of use of tangible working resources and their impact on the final results of the enterprise.

The theoretical and methodological basis of the study are the scientific works of foreign and domestic scientists on selected issues. In the course of the research general scientific methods of analysis (for analysis of recent research and publications of both foreign and domestic authors) and synthesis (for the formation of initial data for correlation analysis), comparison (for factor analysis of profitability of working capital) and generalization of scientific information (formulation of conclusions). In addition, the paper used methods of multifactor correlation-regression analysis and deterministic factor analysis (in assessing the impact of security, turnover and efficiency of material working capital) and modeling (to build a factor model).

Theoretical, methodological and organizational principles of regression analysis of the impact of the level of use of tangible working resources on the value of operating profit of the enterprise have been further developed. For the first time a mathematical model was proposed, which allowed to assess the degree of influence on the results of operating activities of the enterprise such factors as: the share of tangible current resources in the structure of current assets; turnover ratio of tangible current resources; the share of own working capital in tangible working capital; indicator of profitability of tangible current resources.

RESULTS

Based on the analysis of the scientific literature on statistics and econometrics for multifactor correlation analysis [4; 7; 11–13] found that the classical algorithm for constructing a multiple regression model involves the following sequence:

- identification of factors that affect the studied indicator;
- selection of the most significant factors for correlation analysis;
- formation of information support for correlation analysis;
- modelling the relationship between factors and performance (selection of mathematical equations);
- construction of the regression equation;
- calculation of the main indicators of correlation analysis;
- formation of conclusions based on the results of correlation analysis and their practical application.

At the first stage of selection of all possible factors, it is necessary to consider the following conditions: all factors can be measured; it is not recommended to include in the correlation model of linear type the factors, the connection of which with the effective indicator has a curvilinear character; factors whose connection with the performance indicator is of a functional nature cannot be included in the correlation model; lack of multicollinearity between factors.

After selecting the factors and appropriately evaluating the source information, an important task of correlation analysis is to model the relationship between factor and performance indicators, i.e. to select the appropriate equation that will best characterize the studied relationships.

If the connection of all factor indicators with the effective one is rectilinear, then a linear function is used to record such dependences [4; 7]:

$$y = b_0 + b_1x_1 + b_2x_2 + \dots + b_mx_m, \quad (1)$$

where Y – the calculated regression value, which is an estimate of the expected value of Y at fixed values of features x_1, \dots, x_m ; x_1, \dots, x_m – the most significant independent variables; b_0 – parameter that shows the average impact on the performance of factors not included in the model (or not allocated for the study); b_1, \dots, b_m – regression coefficients, each of which shows how many units will change Y with the change of the corresponding feature x per unit, provided that the last features do not change.

The parameters of the multiple regression equation are estimated by the least squares method, which assumes the solution of a system of linear algebraic equations:

$$\begin{cases} \Sigma y = b_0 + b_1 \Sigma x_1 + b_2 \Sigma x_2 + b_3 \Sigma x_3 + b_4 \Sigma x_4 \\ \Sigma yx_1 = b_0 \Sigma x_1 + b_1 \Sigma x_1^2 + b_2 \Sigma x_1x_2 + b_3 \Sigma x_1x_3 + b_4 \Sigma x_1x_4 \\ \Sigma yx_2 = b_0 \Sigma x_2 + b_1 \Sigma x_1x_2 + b_2 \Sigma x_2^2 + b_3 \Sigma x_2x_3 + b_4 \Sigma x_2x_4 \\ \Sigma yx_3 = b_0 \Sigma x_3 + b_1 \Sigma x_1x_3 + b_2 \Sigma x_2x_3 + b_3 \Sigma x_3^2 + b_4 \Sigma x_3x_4 \\ \Sigma yx_4 = b_0 \Sigma x_4 + b_1 \Sigma x_1x_4 + b_2 \Sigma x_2x_4 + b_3 \Sigma x_3x_4 + b_4 \Sigma x_4^2 \end{cases} \quad (9)$$

The initial data for solving the system of equations (9) are given in Tables 1 and 2.

Table 1. Initial data on Kolos LLC for correlation analysis. (Source: calculated by the authors on the basis of financial statements)

Year	Financial result from operating activities (Y), thousand UAH	The share of MCR in current assets (x ₁), %	MCR turnover ratio (x ₂)	The share of working capital in the MCR (x ₃)	Profitability of MCR (x ₄), %
2006	1 354.00	68.45	3.15	1.06	16.14
2007	1 041.00	64.98	2.90	1.14	11.56
2008	895.00	59.30	2.10	0.91	16.72
2009	1 897.00	79.48	3.12	0.84	28.49
2010	1 586.00	64.25	3.37	1.16	22.24
2011	1 258.00	71.98	3.30	0.94	18.41
2012	1 831.00	67.23	3.69	1.09	24.43
2013	442.00	68.08	2.79	1.31	6.12
2014	-791.00	77.90	2.32	1.00	-10.39
2015	-387.00	74.34	2.44	1.11	-4.69
2016	-87.00	72.80	2.81	1.08	-1.09
2017	906.00	71.17	3.24	1.28	11.02
2018	1 261.00	75.98	3.08	1.13	13.23
2019	489.00	79.53	2.71	1.11	4.48
2020	578.00	80.41	2.78	1.12	4.65
2021	647.00	81.74	2.83	1.08	4.71

Table 2. Estimated data to determine the parameters of the regression equation. (Source: calculated by the authors based on the data in Table 1)

Σy	Σyx_1	Σyx_2	Σyx_3	Σyx_4
12 920.00	911 635.02	41 126.42	13 785.99	25 3487.53
Σx_1	Σx_2	Σx_3	Σx_4	Σx_1^2
1 157.62	46.63	17.36	166.03	84 410.34
Σx_2^2	Σx_3^2	Σx_4^2	Σx_1x_2	Σx_1x_3
138.42	19.06	3 444.68	3 370.33	1 254.63
Σx_1x_4	Σx_2x_3	Σx_2x_4	Σx_3x_4	
11 592.30	50.73	527.53	174.73	

Substitute the found data into a system of normal equations:

$$\begin{cases} 12\,920 = b_0 + 1\,157.62b_1 + 46.63b_2 + 17.36b_3 + 166.03b_4 \\ 911\,635.02 = 1\,157.62b_0 + 84\,410.34b_1 + 3\,370.33b_2 + 1\,254.63b_3 + 11\,592.30b_4 \\ 41\,126.42 = 46.63b_0 + 3\,370.33b_1 + 138.42b_2 + 50.73b_3 + 527.53b_4 \\ 13\,785.99 = 17.36b_0 + 1\,254.63b_1 + 50.73b_2 + 19.06b_3 + 174.73b_4 \\ 25\,3487.53 = 166.03b_0 + 11\,592.30b_1 + 527.53b_2 + 174.73b_3 + 3\,444.68b_4 \end{cases}$$

Find the determinant of the system and partial determinants, based on which we calculate the parameters of the regression equation:

$$b_0 = -1\,969.82; b_1 = 13.12; b_2 = 103.85; b_3 = 731.64; b_4 = 72.21.$$

Then the equation of the relationship, which determines the dependence of the financial performance of the enterprise on four factors (the share of MCR in the structure of current assets; MCR turnover ratio; share of own working capital in MCR; profitability of MCR) will be as follows:

$$Y = -1\,984.7 + 13.07x_1 + 103.85x_2 + 731.64x_3 + 72.1x_4.$$

Thus, with an increase in the share of tangible current resources in the structure of current assets of Kolos LLC by 1% financial result from operating activities increases by 13.07 thousand UAH. With increasing turnover ratio of tangible current resources per unit by UAH 103.85 thousand, while the share of own working capital in tangible current resources per unit increases, the financial result from operating activities increases by UAH 731.64 thousand and with the increase in the profitability of tangible current resources by 1%, the financial result from operating activities increases by 72.1 thousand UAH.

However, on the basis of regression coefficients it is impossible to judge which of the factor features has the greatest impact on the effective, because the regression coefficients are incomparable, because they are expressed in different units. In order to identify the comparative force of the influence of individual factors and their reserves, statistics calculates the partial coefficients of elasticity ε_1 .

$$\varepsilon_i = b_i \frac{\bar{x}_i}{\bar{y}}, \quad (10)$$

where b_i – regression coefficient for the i -th factor; \bar{x}_i – the average value of the i -th factor; \bar{y} – the average value of the calculated (theoretical) performance characteristic.

Partial coefficients of elasticity show how many percent on average the effective feature will change when changing by 1% of each factor and the fixed position of other factors. Accordingly, the coefficients of elasticity are:

$$\varepsilon_1 = 1.172; \varepsilon_2 = 0.375; \varepsilon_3 = 0.983; \varepsilon_4 = 0.928.$$

Analysis of partial elasticity coefficients shows that the greatest impact on the financial result from operating activities of Kolos LLC has the level of MCR in current assets, in particular, with an increase in the share of MCR in current assets by 1% financial result from operating activities increases by 1.172%. with an increase in the share of working capital in the MCR by 1% the financial result from operating activities increases by 0.983%, with an increase in the profitability of the MCR by 1%, the financial result from operating activities increases by 0.928%. At the same time, the factor such as the turnover ratio of MCR (0.375%) has the least impact on the operating result of Kolos LLC.

Since, according to the calculations, the share of MCR in current assets had the greatest impact on changes in operating profit, it is advisable to conduct a factor analysis of the efficiency of material working capital. At the same time, it should be noted that the main factor in improving the efficiency of its use is the acceleration of turnover at all stages of the capital cycle of the enterprise. Therefore, using the technique of factor systems expansion, the following factor model is constructed:

$$P_{MCR} = \frac{FR_{OD}}{ACTWC} = \frac{FR_{OD}}{ACTWC} \cdot \frac{NI}{NI} = \frac{FR_{OD}}{NI} \cdot \frac{NI}{ACTWC} \quad (11)$$

where P_{MCR} – profitability of material current resources; FR_{OD} – financial result from operating activities; $ACTWC$ – the average cost of tangible working capital; NI – net income.

In this case, the comparison of the financial result from operating activities with net income allows you to calculate the operating margin of sale (OM_s), which characterizes the amount of operating profit received from each hryvnia net income, and if in percent, the share of operating profit in total revenue from sales.

Based on the ratio of net income and the average cost of tangible current resources determine the turnover ratio of tangible current resources (K_{TRTCR}). The increase in this ratio characterizes the acceleration of the turnover of tangible working resources, as well as indicates the release of tangible working resources and the possibility of their use for other purposes of the enterprise. In addition, accelerating the turnover of tangible working resources can reduce storage costs,

increase production without additional financial resources, which ultimately helps to increase profitability and improve the financial condition of the enterprise.

Given the above, the effective indicator of profitability of tangible current resources will be presented in the form of a multiplicative model:

$$P_{MCR} = \frac{FR_{OD}}{NI} \cdot \frac{NI}{ACTWC} = OM_S \cdot K_{TR_{TCR}} \quad (12)$$

Let's test the specified factor model, using data of activity of LLC Kolos (Table 3).

Table 3. Initial data for factor analysis of profitability of Kolos LLC. (Source: calculated by the authors on the basis of financial statements)

Indicator	2018	2019	2020	2021	Absolute deviation (2021–2020)
Financial result from operating activities, thousand UAH	1261	489	511	520	+9
Net income, thousand UAH	29362	29556	29800	30124	+324
Average annual cost of tangible working capital, thousand UAH	10631	10905	10990	11034	+44
Profitability of tangible current resources,%	13,23	4,48	4,65	4,71	+0,06
Operating return on sales, %	4,29	1,65	1,71	1,72	+0,01
Turnover ratio of tangible current resources	3,08	2,71	2,78	2,83	+0,05
Duration of one turnover of material current resources ($T_{ob_{MCR}}$), days	119	135	133	132	-1

Using the method of absolute differences, we will conduct a factor analysis of the return on working capital of non-monetary capital of Kolos LLC:

$$\Delta P_{MCR} = (1,72 \% - 1,71 \%) \cdot 2,78 = +0,03;$$

$$\Delta P_{MCR} = 1,72 \% \cdot (2,83 - 2,78) = +0,09.$$

Thus, in 2021 at Kolos LLC there is an increase in the profitability of tangible current resources by 0.06 points, which indicates a deterioration in the efficiency of their use. This increase in profitability was due to the following factors: increase in operating profitability of sales led to a decrease in profitability of tangible working capital by 0.01 points; the increase in the turnover ratio of tangible current resources also had a positive effect on the profitability of tangible current resources, which led to its increase by 0.05 points.

In addition, it is advisable to calculate the economic effect obtained by accelerating the turnover of tangible current resources, which is the release from circulation of these resources, i.e. the company can with the same amount of tangible working capital to produce more or produce the same amount of production with less tangible working capital resources.

Since the duration of one turnover of tangible current resources is equal to the ratio of the number of calendar days in the analyzed period to the turnover ratio of tangible assets, using the method of absolute differences, you can calculate the amount of release of tangible assets by accelerating their turnover or the amount of additional involved in the turnover of material circulating resources due to the slowdown of their turnover:

$$\Delta ACTWC = (T_{ob_{MCR_{2021}}} - T_{ob_{MCR_{2020}}}) \cdot \frac{NI_{2020}}{\text{Days}} \quad (13)$$

$$\Delta ACTWC = (132 - 133) \cdot \frac{29\,800}{365} = -81,64$$

Thus, at Kolos LLC, as a result of slowing down the turnover of tangible working resources, additional tangible working resources in the amount of UAH 81.64 thousand were additionally withdrawn from circulation.

Acceleration of turnover of tangible working resources should be achieved through the introduction of new equipment, advanced resource-saving technologies and automation of production, which, in turn, will reduce the duration of the production cycle and, consequently, increase production and sales. Also to accelerate the turnover of material current resources is important: rational organization of logistics; creation of optimal volumes of production stocks with the application of the principle of optimal price-quality ratio; reduction of material and energy consumption of products; economical

use of material resources through integrated processing of raw materials, use of waste and organization of the use of secondary resources; introduction of a system of motivation for the rational use of material resources; improving the marketing activities of the enterprise, in particular, stimulating the sale of finished products, etc.

CONCLUSIONS

Thus, the use of multifactor correlation-regression and deterministic factor analysis in assessing the impact of the level of security, turnover and efficiency of material assets on the results of operating activities of the entity is an important tool in the process of making management decisions to form a portfolio of material orders, improving the efficiency of their use and developing measures for their mobilization. The four-factor regression model constructed with the help of correlation-regression analysis allowed to draw a conclusion that the significant factors that have the greatest influence on the results of operating activity of the researched enterprise are profitability of material circulating resources and turnover ratio of material resources. The proposed analytical support of the process of managing the operational activities of the enterprise allows to increase the efficiency of providing analytical information in the time management system on existing and potential opportunities to improve the use of tangible working resources as one of the main factors influencing the formation of operating results.

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РЕГРЕСІЙНИЙ АНАЛІЗ ОПЕРАЦІЙНОГО ПРИБУТКУ КОМПАНІЇ

Метою статті є подальший розвиток методичних положень щодо економічного аналізу ефективності використання матеріальних оборотних ресурсів та їхнього впливу на кінцеві результати діяльності підприємства. Теоретико-методологічною базою дослідження є наукові праці зарубіжних і вітчизняних науковців з обраної проблематики. У процесі дослідження використано загальнонаукові методи аналізу, синтезу, порівняння та узагальнення наукової інформації. Крім того, при написанні роботи використовувалися методи багатofакторного кореляційно-регресійного аналізу та детермінованого факторного аналізу. Запропоновано математичну модель, яка дозволила оцінити ступінь впливу на результати операційної діяльності підприємства таких факторів, як: питома вага матеріальних оборотних ресурсів у структурі оборотних активів; коефіцієнт оборотності матеріальних оборотних ресурсів; частка власних оборотних засобів у матеріальних оборотних ресурсах; показник рентабельності матеріальних оборотних ресурсів. Розрахунково встановлено, що 85 % варіації виокремленого результативного показника зумовлено варіацією обраних факторів. Також проведено факторний аналіз ефективності використання матеріальних оборотних ресурсів і розраховано економічний ефект, отриманий від прискорення оборотності матеріальних оборотних ресурсів. Набули подальшого розвитку теоретичні, методичні та організаційні засади регресійного аналізу впливу рівня використання матеріальних оборотних ресурсів на величину операційного прибутку підприємства. Уперше запропоновано математичну модель, яка дозволила оцінити ступінь впливу на результати операційної діяльності підприємства таких факторів, як: питома вага матеріальних оборотних ресурсів у структурі оборотних активів; коефіцієнт оборотності матеріальних оборотних ресурсів; частка власних оборотних засобів у матеріальних оборотних ресурсах; показник рентабельності матеріальних оборотних ресурсів. Практична цінність наукового дослідження полягає в тому, що запропоноване аналітичне забезпечення процесу управління операційною діяльністю підприємства дозволяє підвищити оперативність надання аналітичної інформації в системі тайм-менеджменту про наявні та потенційні можливості підвищення ефективності використання матеріальних оборотних ресурсів як одного з основних чинників впливу на формування результатів операційної діяльності для досягнення всіма учасниками господарської діяльності своїх фінансових цілей.

Ключові слова: матеріальні оборотні ресурси, фінансовий результат від операційної діяльності, рівняння регресії, факторний аналіз

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