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STATISTICAL ANALYSIS OF THE RELATIONSHIP OF THE ENTERPRISE INDICATORS OF CAPITAL USE EFFICIENCY AND PROFITABILITY

Formulation of the problem. In a market economy the importance of financial resources increases dramatically. With their help the formation of the enterprise optimal structure and increasing of the productive capacity, as well as the financing of current economic activity is carried out. From the fact what volume of capital has a business entity, how optimal is its structure, how reasonable it is transformed into fixed and working capital, the financial state depends on the company and its financial performance. Therefore, the analysis of the availability, sources of formation and capital allocation is crucial.

Capital efficiency has a decisive impact on such summarizing indicators of an enterprise work efficiency as profit and profitability.

The faster the capital will make the turnover, the more the company will receive and sell products with the same amount of capital for a certain period of time.

Delay movement of funds at any stage leads to slower capital turnover, requires additional investment and can cause a significant deterioration in the company financial condition.

Achieved by accelerating the turnover effect is primarily in increasing the output without additional attraction of financial resources. In addition, due to the acceleration of capital turnover is an increase in the amount of profit, because the capital usually returns to the original form of money in increments.

Thus, it is necessary to strive not only to accelerate the movement of capital at all stages of circulation, but also to its maximum impact. Increase return on capital is achieved by rational and economical use of all resources, preventing their overspending, losses at all stages of the turnover. As a result, capital will return to its original state to a greater amount, i.e. with a profit.

Analysis of recent publications. Theoretical questions of formation and use of capital were considered in the works of numerous foreign and domestic scientists: I.Balabanov [4], V.Belolipetskii [5], I.Blank [6], V. Kovalev [11], G. Savitskaya [12], V. Savchuk [13] and other. However, there remains a number of open questions in the framework of the establishment of quantitative relationships of capital use indicators and effectiveness of certain economic activity entities.

The aim of the article is to develop proposals to improve the efficiency of capital management and profitability of the enterprise by applying statistical analysis techniques.

Statement of the base material. By using statistical methods for studying dependencies it is advisable to use the indicators of capital use intensity, i.e. capital productivity indicators, calculated in terms of net revenue, in order to avoid the so-called phenomenon of multicollinearity [7, 8, 10].

To conduct the study using the statistical method it is necessary to define, first of all, the composition of effective and factorial signs.

Efficient features are such ones as: the profitability of the total investment, profitability of equity, the balance sheet profit to total assets, gross margins, sales profitability (at the balance sheet profit and profit on realization). We will assume factor variable to be capital productivity indicators, indicators of operating capital technical condition, the duration of the financial cycle and others.

Due to the presence of small numbers of observations, on the first stage of statistical research Spearman rank correlation coefficient was applied for the preliminary establishing the connection tightness and direction between the indices. An important feature of the Spearman coefficient is the ability to evaluate the relationship between the variables, regardless of their distribution, because all the variables are replaced by their ranks.

We will show the use of the Spearman coefficient on the example of a pair of indices: the profitability of the total investment (efficient sign) and the combined coefficient of operating capital validity (factorial sign). The values of these parameters and an auxiliary calculations to determine the coefficient of Spearman are presented in table 1.

Spearman coefficient is calculated as follows:

$$r = 1 - \frac{6\sum d^2}{n(n^2-1)} = 1 - \frac{6 \cdot 2}{3 \cdot (9-1)} = 0{,}5$$

For other indicators calculations are made in the same way. Summary of the analysis results using the Spearman rank correlation coefficient is given in table 2.

A low close connection is called a connection with a coefficient equal to or less than 0.3. The values of the coefficient of 0.4 to 0.7 are considered as an indicator of moderate distress, and if the obtained value exceeds 0.7, then one speaks of high distress communication.

**Calculation of Spearman coefficient for the profitability of the total investment
and combined coefficient of operating capital validity**

The profitability of the total investment *(Y)*	Combined coefficient of operating capital validity *(X)*	Ranks		Rank difference *d*	d^2
		Y	X		
-0,0222	0,4237	2	3	1	1
-0,0182	0,9127	1	1	0	0
-0,2985	0,8661	3	2	-1	1
In total					**2**
Coefficient of Spearman					**0,5**

**Summary of the relationship's analysis results of the capital use indicators
and profitability using Spearman coefficient**

Factorial index	Efficient index			
	The profitability of the total investment; Profitability of equity capital; Balance profit on total assets; The profitability of sales on the balance sheet profit; The profitability of sales profit from the sale		Gross margin	
	The value of the coefficient	The conclusion about the distress and the direction of communication	The value of the coefficient	The conclusion about the distress and the direction of communication
Combined coefficient of operating capital validity	0,5	direct communication, moderate tightness	-0,5	feedback, moderate tightness
Accounts receivable turnover	-0,5	feedback, moderate tightness	-1	feedback, high tightness
The financial cycle	-0,5	feedback, moderate tightness	-1	feedback, high tightness
Turnover of working capital	-0,5	feedback, moderate tightness	-1	feedback, high tightness
Turnover of fixed capital	-0,5	feedback, moderate tightness	-1	feedback, high tightness
Capital productivity of fixed capital	-1	feedback, high tightness	-0,5	feedback, moderate tightness
Capital productivity of all assets	-0,5	feedback, moderate tightness	-1	feedback, high tightness
Capital productivity of material circulating assets	-0,5	feedback, moderate tightness	-1	feedback, high tightness
Capital productivity of cash and payments	-0,5	feedback, moderate tightness	-1	feedback, high tightness
Capital productivity of net working capital	-0,5	feedback, moderate tightness	-1	feedback, high tightness
Coefficient of autonomy	0,5	direct communication, moderate tightness	1	direct connection, high tightness
Accounts payable turnover	0,5	direct communication, moderate tightness	1	direct connection, high tightness
Equity multiplier	-0,5	feedback, moderate tightness	-1	feedback, high tightness

Thus, when using the non-parametric Spearman coefficient of rank correlation, it was found that all indicators, except for gross margin, have a predominantly moderate tightness and reverse direction with the factor variable. In the analysis of the gross margin and factorial signs relationship mainly feedback with high tightness was installed.

Since the power of parametric correlation coefficient exceeds the capacity of Spearman's rank correlation coefficient, we can apply the methods of correlation – regression analysis, which will allow not only to clarify the closeness and direction of connection, but also to form equations and multiple regression, which have practical importance.

To ensure representativeness of statistical sample, efficient and factorial indicators were adopted in the quarterly context.

Connection tightness between the studied traits was determined by pair correlation coefficients. Checking the reliability of pair correlation coefficients was performed by t-Student criterion with a confidence level of 95%.

The coefficient matrix of pair correlation between the studied traits is shown in table 3.

The table shows that the most significant statistical relationship (correlation coefficient greater than 0.7) was found between these indicators of profitability and the use of capital:

- the profitability of total investment, the profitability of equity, the profitability of sales on the balance sheet profit and the following factorial signs: the financial cycle, the turnover of non-negotiable capital, capital productivity of net working capital, equity ratio and equity multiplier;

Table 3

Matrix of pair correlation coefficients

Indicators	Profitability of total investment	Profitability of equity capital	Balance profit on total assets	Gross margin	Profitability of sales on balance sheet profit	Profitability of sales profit from sale
Combined coefficient of operating capital validity	-0,320	-0,320	-0,380	-0,520	-0,350	-0,360
Accounts receivable turnover	-0,480	-0,480	**-0,710**	**-0,800**	-0,680	**-0,720**
The financial cycle	**0,705**	**0,706**	**0,811**	**0,883**	**0,773**	**0,792**
Turnover of working capital	-0,520	-0,520	**-0,700**	**-0,760**	-0,680	**-0,700**
Turnover of fixed capital	**-0,720**	**-0,720**	**-0,940**	**-0,940**	**-0,930**	**-0,950**
Capital productivity of fixed capital	-0,490	-0,490	-0,670	-0,590	-0,680	*-0,710*
Capital productivity of all assets	-0,100	-0,100	-0,460	-0,380	-0,540	-0,540
Capital productivity of material circulating assets	-0,510	-0,510	-0,680	**-0,750**	-0,670	-0,690
Capital productivity of cash and payments	-0,530	-0,530	**-0,700**	**-0,760**	-0,690	**-0,710**
Capital productivity of net working capital	**-0,790**	**-0,790**	**-0,930**	**-0,940**	**-0,870**	**-0,900**
Coefficient of autonomy	**0,924**	**0,924**	**0,892**	**0,910**	**0,774**	**0,811**
Accounts payable turnover	0,626	0,626	**0,748**	0,681	**0,741**	**0,700**
Equity multiplier	**-0,960**	**-0,960**	**-0,800**	**-0,900**	**-0,690**	**-0,740**

-- balance profit on total assets, and such factors as: the turnover of accounts receivable and payable, financial cycle, the turnover of working and fixed capital, capital productivity of cash payments and net working capital, equity ratio and equity multiplier;

- gross margin and the following factors: the turnover of accounts receivable, financial cycle, the turnover of working and fixed capital, capital productivity tangible current assets, cash and settlement, as well as the net working capital, equity ratio and equity multiplier;

- the profitability of sales profit from the sale of such factors as: the turnover of accounts receivable and payable, financial cycle, the turnover of working and fixed capital, return on assets of fixed capital, capital productivity of cash payments and net working capital, equity ratio and equity multiplier.

It should be noted that in most relationships there is feedback (as evidenced by a minus sign in the coefficient of pair correlation). This is due to the fact that the effectiveness of activities (i.e. profitability) indices is negative, that is, in reality, it is unprofitable. Consequently, the reversed relationship between these negative results with the selected factor variable is logical. At the same time, we note that in the analysis we have a direct relationship of all efficient indicators with such factors as, for example, the financial cycle. This is true, as the factor itself also has a reverse direction, i.e. the smaller it is, the better. Therefore, the use of correlation - regression analysis is not "mechanical", and takes into consideration the economic sense of the studied parameters.

Pair regression equations parameters as linear functions (y = a + bx) between the indices of capital use and enterprise profitability, having a value of pair correlation coefficients greater than 0.7, are listed in Table 4.

Multifactorial regression models that allow us to establish a statistical relationship between one of the resulting symptoms (rate of profitability) and a set of the capital use indicators are also presented.

The coefficients corresponding to the factorial traits characterize the partial effect of each capital use indicator in enterprise profitability. In other words, the coefficients of the variables show how many points will the result be changed at one percent change of the factor.

The obtained regression equations are of practical importance, since the knowledge of the quantitative relationship between the profitability and capital use indicators allow the industrial and financial managers choose priority areas of financial management of the enterprise.

Conclusions. The study suggested the use of statistical analysis methods in order to establish the relationship between indicators of capital use efficiency and profitability of industrial enterprises. The system of performance indicators, including factorial and productive features is formed. The presence, tightness and direction of the connection among performance indicators were revealed, as well as equations and multiple regression were formed. Using the considered technique will provide extensive information base for the acceptance and support of management decisions in the field of financial management.

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Table 4

Regression equations between indicators of profitability and capital use

Y \ X	Profitability of investment	Profitability of total capital	Profitability of equity capital	Balance profit on total assets	Gross margin	Profitability of sales on balance sheet profit	Profitability of sales profit from sale
Accounts receivable turnover`				-0,0694x+0,3013	-0,0468x+0,3057		-0,0334x+0,1753
The financial cycle	0,0051x-0,4158		0,0052x-0,4243	0,0032x-0,2758	0,0021x-0,0787	0,0018x-0,1586	0,0015x-0,0986
Turnover of working capital				-0,1013x+0,2667	-0,0658x+0,2741		-0,0481x+0,1564
Turnover of fixed capital	-0,2140x+0,3338		-0,2186x+0,3414	-0,1555x+0,2415	-0,0922x+0,2389	-0,0883x+0,1312	-0,0742x+0,1450
Capital productivity of fixed capital							-0,0586x+0,1716
Capital productivity of material circulating assets					-0,0193x+0,2630		
Capital productivity of cash and payments				-0,0718x+0,2756	-0,0469x+0,2792		-0,0342x+0,1608
Capital productivity of net working capital	-0,0306x+0,1228		-0,0312x+0,1258	-0,0200x+0,0714	-0,0121x+0,1396	-0,0108x+0,0300	-0,0091x+0,0604
Coefficient of autonomy	1,6862x-1,4934		1,7216x-1,5244	0,8997x-0,8198	0,5489x-0,4028	0,4480x-0,4201	0,3863x-0,3261
Accounts payable turnover				0,0304x-0,3847		0,0173x-0,2248	0,0134x-0,1433
Equity multiplier	-0,7346x+0,8564		-0,7501x+0,8747	-0,3397x+0,3649	-0,2282x+0,3475	-0,1687x+0,1693	-0,1481x+0,1855
The equation of multiple regression	$-0,0035x_1+0,0261x_2-0,0069x_3+0,3230x_4-0,8705x_5+0,9767$		$-0,0035x_1+0,0263x_2-0,0070x_3+0,3294x_4-0,8881x_5+0,9973$	$-0,0097x_1-0,0009x_2-2,5235x_3-0,2677x_4+1,84x_5+0,0022x_6+0,2988x_7+0,0020x_8+0,0551x_9-0,2418$	$-0,0208x_1-0,0017x_2-0,1130x_4-0,1572x_5+0,3933x_6-0,0026x_7-0,0616x_8-0,1458x_9+0,5648$	$-0,0003x_1-0,1056x_2+0,0027x_3+0,2108x_4+0,0051x_5-0,0988x_6-0,1918$	$-0,001x_1+0,0002x_2-0,1682x_4+0,0274x_5+0,0426x_6+0,0016x_7+0,0138x_8-0,0011x_9+0,0436x_{10}-0,0363$

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Чєрната Т. М. Статистичний аналіз взаємозв'язку показників ефективності використання капіталу та прибутковості підприємства

У статті запропоновано використання статистичних методів з метою встановлення та аналізу взаємозв'язку між показниками ефективності використання капіталу та прибутковості промислового підприємства. Наведено склад результативних та факторних ознак, що використовуються для аналізу. Використано коефіцієнт рангової кореляції Спірмена для попереднього встановлення тісноти та напрямку зв'язку між показниками. На подальшому етапі застосовано методи кореляційно-регресійного аналізу, які дозволили сформувати рівняння парної та множинної регресії, що складають ємну інформаційну базу для прийняття та обґрунтування управлінських рішень у сфері фінансового менеджменту.

Ключові слова: капітал, прибутковість, статистичні методи, ефективність, взаємозв'язок, кореляційно-регресійний аналіз, статистична вибірка, коефіцієнт.

Чєрната Т. Н. Статистический анализ взаимосвязи показателей эффективности использования капитала и прибыльности предприятия

В статье предложено использование статистических методов с целью установления и анализа взаимосвязи между показателями эффективности использования капитала и прибыльности промышленного предприятия. Приведен состав результативных и факторных признаков, которые используются для анализа. Использован коэффициент ранговой корреляции Спирмена для предварительного установления тесноты и направления связи между показателями. На дальнейшем этапе применены методы корреляционно-регрессионного анализа, что позволило сформировать уравнения парной и множественной регрессии, которые составляют емкую информационную базу для принятия и обоснования управленческих решений в области финансового менеджмента.

Ключевые слова: капитал, прибыльность, статистические методы, эффективность, взаимосвязь, корреляционно-регрессионный анализ, статистическая выборка, коэффициент.

Chernata T. Statistical analysis of the relationship of the enterprise indicators of capital use efficiency and the profitability

The article proposed the use of statistical methods in order to establish and analyze the relationship between indicators of industrial enterprises' capital use efficiency and profitability. Effective and factorial indexes were used for analysis. We used Spearman rank correlation coefficient for establishing the preliminary tightness and direction of relationship between indicators. Methods of correlation - regression analysis, allowing to form the equations and multiple regression, which make up the capacious information to adopt and inform decisions in the field of financial management, were also applied

Keywords: capital, profitability, statistical methods, efficiency, relationship, correlation-regression analysis, statistical sampling, coefficient.