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INTEGRAL FACTOR ANALYSIS OF FINANCIAL PROFITABILITY BY FILATOV'S METHOD

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Abstract

Management decisions in today's highly competitive environment can not be taken intuitively, approximately, they should be based on accurate calculations, deep economic analysis.

As applied science, economic analysis is useful and necessary only when, as a result of its application, the efficiency of people's practical activities increases, when it becomes possible to anticipate and predict the development of the economic situation in a particular enterprise and make rational (scientifically based) management decisions.

In the article, the author presented an alternative approach to determine the integrated assessment of the influence of factors on the overall indicator. The author's method of the integral factor analysis (Filatov's method) makes it possible to draw the conclusion about changes in the financial position of the enterprise more accessible, and also represents to estimate the degree of influence of factors on changes of the investigated indicator in the system of managing and trends of its change. Functional analysis is aimed at identifying the impact of individual factors on the effective indicator, so deterministic modeling of factor systems is a simple and effective means of formalizing the relationship of economic indicators, which serves as a basis for quantifying the role of individual parameters in the dynamics of the change of the overall indicator.

Keywords: Factor analysis, integral method, deflection, additional growth of the effective indicator, financial profitability.

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1. Introduction

The market economy defines specific requirements for the management system of enterprises. It is necessary to react more quickly to changes in the economic situation in order to maintain a stable financial condition and continuous improvement of production in accordance with changes in the market conjuncture (Leung, 1996).

In order to correctly assess the effectiveness of decisions made on the basis of analysis data, enterprise management must be justified. Management decisions in today's highly competitive environment can not be taken intuitively, approximately, they should be based on accurate calculations, deep economic analysis. These results of the analysis are thus the basis for the development and adoption of management decisions. Economic analysis is a function of management to ensure scientific decision-making. The basis of the analysis is a system of indicators and analytical tables, the logic of selection and compilation of which involves the analysis of the state and dynamics of the economic potential of the enterprise, the results and efficiency of its use.

Deterministic factor analysis is aimed at identifying the influence of factors on the amount of interest the effective rate excluding margin of error, it is most relevant for practical application in the conditions of market relations.

An integral method (reception of differential-integral calculus) is a method of inconsistent elimination. This method eliminates the main drawback inherent in the traditional methods of studying the direct deterministic factor relationship (chain substitutions and the method of differences) – the need to determine the sequence of replacement of the values of the factors, which is sometimes difficult with their large number, while changing the sequence affects the result of the calculation.

The integral method (the acceptance of differential-integral calculus) allows one to achieve the complete decomposition of the effective index factors and is universal in nature (decomposed an additional increase in the effective index in connection with the interaction of factors equally between them regardless of their location in the model). That is, this method is used to measure factors in a multiplicative, multiple and mixed models of multiple-additive type.

2. Problem Statement

When using the integral method, the peculiarities of the influence of quantitative and qualitative factors were not taken into account; the actions of which were considered equal, so there are deviations in the results of calculations by factors in comparison with calculations performed by the method of chain substitutions and by the method of absolute and relative differences.

The traditional integral method for multiplicative models is applicable only to two, three and four factors included in the functional model (Bakanov, 2004; Bakanov & Sheremet, 2000; Barngolts & Tatsiy, 1981; Endovitsky, 2009; Gilyarovskaya, 2001, 2002; Ionova, 2012; Sokolova, 2011; Voytolovsky, 2006, 2011). The author's method can be used to any number of factors included in the functional model.

The main task of the author's integral method of factor analysis (Filatov's method) (Filatov, 2014), as well as the known ones, is to identify factors that determine the total change of the studied indicator. The main purpose of factor analysis is to obtain the key (most informative) parameters that give an objective and accurate picture of the changes in the indicator under study.

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Rationally organized information flow, systematized and processed data serve as the basis for building models in accordance with the tasks of analysis (Eitman, 2013).

Modeling of multiplicative factor systems is carried out by sequentially dividing the factors of the original system into factors-factors (Inglehart, 1994). With the deterministic factor, models investigated a functional link between a productive indicator and factors to formalize the integral method selected multiplicative dependence is a dependence in which all factors are multiplied together.

The correct interpretation of the performance evaluation can be carried out in the analysis of the relationship between the indicators (Choi, 2003). Therefore, to characterize the efficiency of the enterprise as a whole, the profitability of different activities (production, administrative, economic, financial) in the economic analysis, profitability indicators are calculated.

3. Research Questions

Profitability indicators are important elements that reflect the factor environment of profit formation of enterprises. Therefore, they are mandatory for comparative analysis and assessment of the financial condition of the company.

The signal indicator, which shows the financial condition of the enterprise, is the indicator of financial profitability. The return on equity or financial profitability (Rf) is a rate representing the ratio of net profit to average amount of own capital. In this case, the original formula for factor analysis will be as follows (formula 1):

$$\boldsymbol{R_f} = \frac{\boldsymbol{ZK}}{\boldsymbol{SK}} * \frac{\boldsymbol{SA}}{\boldsymbol{ZK}} * \frac{\boldsymbol{VA}}{\boldsymbol{SA}} * \frac{\boldsymbol{OA}}{\boldsymbol{VA}} * \frac{\boldsymbol{SS}}{\boldsymbol{OA}} * \frac{\boldsymbol{V}}{\boldsymbol{SS}} * \frac{\boldsymbol{P}}{\boldsymbol{V}} = \boldsymbol{F_1} * \boldsymbol{F_2} * \boldsymbol{F_3} * \boldsymbol{F_4} * \boldsymbol{F_5} * \boldsymbol{F_6} * \boldsymbol{F_7} = \prod_{n=1}^{7} \boldsymbol{F_n} \tag{1}$$

where: $\boldsymbol{R_f}$ – financial profitability; $\boldsymbol{ZK}$ – the average cost of borrowed capital; $\boldsymbol{SK}$ – the average cost of equity; $\boldsymbol{SA}$ – value of assets; $\boldsymbol{VA}$ – the average value of non-current assets; $\boldsymbol{OA}$ – the average value of current assets; $\boldsymbol{SS}$ – cost of sales (goods, works, services); $\boldsymbol{V}$ – net revenue, revenue from the sale of products, goods, works, services, in other words, all the revenue that the company receives less taxes calculated from it (VAT, excise duties and similar mandatory payments); $\boldsymbol{P}$ – net profit (profit after income tax): distributable profit); $\boldsymbol{F_1} = \frac{\boldsymbol{ZK}}{\boldsymbol{SK}}$ – shoulder of the financial lever (ratio of financial risk); $\boldsymbol{F_2} = \frac{\boldsymbol{SA}}{\boldsymbol{ZK}}$ – the ratio of total capital to borrowed; $\boldsymbol{F_3} = \frac{\boldsymbol{VA}}{\boldsymbol{SA}}$ – share of immobilization capital in total capital; $\boldsymbol{F_4} = \frac{\boldsymbol{OA}}{\boldsymbol{VA}}$ – ratio of working capital to non-working capital; $\boldsymbol{F_5} = \frac{\boldsymbol{SS}}{\boldsymbol{OA}}$ – ratio of cost of production to current assets; $\boldsymbol{F_6} = \frac{\boldsymbol{V}}{\boldsymbol{SS}}$ – the ratio of profit and cost of production; $\boldsymbol{F_7} = \frac{\boldsymbol{P}}{\boldsymbol{V}}$ – profitability of sales.

4. Purpose of the Study

Determining the influence of factors on the result is one of the strongest methodological decisions in the analysis of companies ' economic activities for decision-making. Therefore, the main goal of the integrated author's analysis is to reveal the influence of seven factors on the change of the resulting indicator – the change in the financial profitability of the enterprise.

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5. Research Methods

The basis of the analysis is a system of indicators and analytical tables, the logic of selection and compilation of which involves the analysis of the state and dynamics of the economic potential of the enterprise, the results and efficiency of its use. The initial data for the integrated factor analysis are presented in table 1.

Table 01. The initial data for factor analysis

No.	Indicators	№ factor's	Plan (0)	Fact (I)	Deviation (Δ)
1	V – The net revenue, thousand $		1 500 000	1 923 000	+ 423 000
2	SS – Cost of sales, thousand $		1 110 000	1 375 000	+ 275 000
3	ZK – The average cost of borrowed capital, thousand $		680 000	875 000	+ 195 000
4	SK – The average cost of equity, thousand $		1 000 000	1 250 000	+ 250 000
5	VA – The average value of non-current assets, thousand $		900 000	1 200 000	+ 300 000
6	OA – The average value of current assets, thousand $		780 000	925 000	+ 145 000
7	SA – Value of assets (capital) or balance sheet currency, thousand $ (3 + 4) и (5 + 6)		1 680 000	2 125 000	+ 445 000
8	P – Net profit, thousand $		200 000	350 000	+ 150 000
9	R_f – **Financial profitability** 8/4 = (10 * 11 * 12 * 13 * 14 * 15 * 16)		0.20	0.28	+ 0.08
10	Coefficient of financial risk (3/4)	F_1	0.68	0.70	0.02
11	The ratio of total capital to borrowed (7/3)	F_2	2.470588	2.428571	-0.042017
12	Share of immobilization capital in total capital (5/7)	F_3	0.535714	0.564706	0.028992
13	The ratio of current and non-current capital (6/5)	F_4	0.866667	0.770833	-0.095833
14	The ratio of the cost of production to current assets (2/6)	F_5	1.410256	1.486486	0.076230
15	The ratio of profit and cost of production (1/2)	F_6	1.363636	1.398545	0.034909
16	Profitability of sales (8/1)	F_7	0.133333	0.182007	0.048674

where: * 0-past (base) period (year) taken as a basis for comparison; ** I – reporting (current) year; * * * – change for the period is calculated as the difference between the fact and the plan (I – 0).

The total deviation of the resultant index ((ΔR_f) is determined by formula 2:

$$\Delta R_f = \sum_{n=1}^{7} \Delta R_f(F_n) = \Delta R_f(F_1) + \Delta R_f(F_2) + \Delta R_f(F_3) + \Delta R_f(F_4) + \Delta R_f(F_5) + \Delta R_f(F_6) + \Delta R_f(F_7), \quad (2)$$

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where: calculation of the influence of factors on the change of the effective indicator is presented in formulas 3.1 – 3.7:

$$\Delta \boldsymbol{R_f}\ \mathbf{(F_1) = (\ (\Delta F_1 / n) * (FO_1)\ ) + Z} \quad \mathbf{(3.1)}$$

$$\Delta \boldsymbol{R_f}\ \mathbf{(F_2) = (\ (\Delta F_2 / n) * (FO_2)\ ) + Z} \quad \mathbf{(3.2)}$$

$$\Delta \boldsymbol{R_f}\ \mathbf{(F_3) = (\ (\Delta F_3 / n) * (FO_3)\ ) + Z} \quad \mathbf{(3.3)}$$

$$\Delta \boldsymbol{R_f}\ \mathbf{(F_4) = (\ (\Delta F_4 / n) * (FO_4)\ ) + Z} \quad \mathbf{(3.4)}$$

$$\Delta \boldsymbol{R_f}\ \mathbf{(F_5) = (\ (\Delta F_5 / n) * (FO_5)\ ) + Z} \quad \mathbf{(3.5)}$$

$$\Delta \boldsymbol{R_f}\ \mathbf{(F_6) = (\ (\Delta F_6 / n) * (FO_6)\ ) + Z} \quad \mathbf{(3.6)}$$

$$\Delta \boldsymbol{R_f}\ \mathbf{(F_7) = (\ (\Delta F_6 / n) * (FO_7)\ ) + Z} \quad \mathbf{(3.7)}$$

where: an additional increase in the performance indicator due to the interaction of factors between them (Z) is presented equally in formula 4.

When using the integral method, the additional gain of the effective indicator ("indecomposable residue" – Z), formed as a result of the interaction of factors, is distributed equally between them:

$$\mathbf{Z} = \Delta \boldsymbol{R_f} - \sum \mathbf{((\Delta F_n / n) * (FO_n)) / n} \quad \mathbf{(4)}$$

where Z – additional increase in the effective indicator due to the interaction of factors equally between them;

FO_n – the main part of the formula of the author's integral method;

ΔF_n – deviation by a certain factor;

n – the number of factors involved in the analysis.

where: FO_n – the main part of the formula of the author's integral method is calculated by formulas 5.1 – 5.7.

$$\mathbf{FO_1 = 2 * (\ (F_{2(0)}*F_{3(I)}*F_{4(0)}*F_{5(I)}*F_{6(0)}*F_{7(I)}) + (F_{2(I)}*F_{3(0)}*F_{4(I)}*F_{5(0)}*F_{6(I)}*F_{7(0)})\ )} \quad \mathbf{(5.1)}$$

$$\mathbf{FO_2 = 2 * (\ (F_{1(0)}*F_{3(I)}*F_{4(0)}*F_{5(I)}*F_{6(0)}*F_{7(I)}) + (F_{1(I)}*F_{3(0)}*F_{4(I)}*F_{5(0)}*F_{6(I)}*F_{7(0)})\ )} \quad \mathbf{(5.2)}$$

$$\mathbf{FO_3 = 2 * (\ (F_{1(0)}*F_{2(I)}*F_{4(0)}*F_{5(I)}*F_{6(0)}*F_{7(I)}) + (F_{1(I)}*F_{2(0)}*F_{4(I)}*F_{5(0)}*F_{6(I)}*F_{7(0)})\ )} \quad \mathbf{(5.3)}$$

$$\mathbf{FO_4 = 2 * (\ (F_{1(0)}*F_{2(I)}*F_{3(0)}*F_{5(I)}*F_{6(0)}*F_{7(I)}) + (F_{1(I)}*F_{2(0)}*F_{3(I)}*F_{5(0)}*F_{6(I)}*F_{7(0)})\ )} \quad \mathbf{(5.4)}$$

$$\mathbf{FO_5 = 2 * (\ (F_{1(0)}*F_{2(I)}*F_{3(0)}*F_{4(I)}*F_{6(0)}*F_{7(I)}) + (F_{1(I)}*F_{2(0)}*F_{3(I)}*F_{4(0)}*F_{6(I)}*F_{7(0)})\ )} \quad \mathbf{(5.5)}$$

$$\mathbf{FO_6 = 2 * (\ (F_{1(0)}*F_{2(I)}*F_{3(0)}*F_{4(I)}*F_{5(0)}*F_{7(I)}) + (F_{1(I)}*F_{2(0)}*F_{3(I)}*F_{4(0)}*F_{5(I)}*F_{7(0)})\ )} \quad \mathbf{(5.6)}$$

$$\mathbf{FO_7 = 2 * (\ (F_{1(0)}*F_{2(I)}*F_{3(0)}*F_{4(I)}*F_{5(0)}*F_{6(I)}) + (F_{1(I)}*F_{2(0)}*F_{3(I)}*F_{4(0)}*F_{5(I)}*F_{6(0)})\ )} \quad \mathbf{(5.7)}$$

The approbation of the author's method of factorial integral analysis given above is presented in tables 3, 4.

To form the main part of the formula (FO_n), it is necessary to use the principle of choice of factors disclosed in table 2.

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Corresponding Author: E.A. Filatov
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Table 02. Selection of factors for the main part of the formula (FOn) by the author's integral method

Under influence # factors	First multiplier						Second multiplier					
	0	**I**	**0**	**I**	**0**	**I**	**I**	**0**	**I**	**0**	**I**	**0**
1	2	3	4	5	6	7	2	3	4	5	6	7
2	1	3	4	5	6	7	1	3	4	5	6	7
3	1	2	4	5	6	7	1	2	4	5	6	7
4	1	2	3	5	6	7	1	2	3	5	6	7
5	1	2	3	4	6	7	1	2	3	4	6	7
6	1	2	3	4	5	7	1	2	3	4	5	7
7	1	2	3	4	5	6	1	2	3	4	5	6

where **m** – the number of indicators in the main part of the formula (table 2); m is determined by formula 6:

$$\mathbf{m = n * (2*(n - 1))} \qquad (6)$$

With 7 factors in the model (n = 7), m will be 84 (m = 7 * (2*6) = 7 * 12).

Table 03. Components of the formula according to the author's integral method

№ formulae	Part of the formula		
	ΔF_n / n	The main part of the formula (FO_n)	Z
1	$\Delta R_f (F_1) = (\Delta F_1/7)*$	$2 * ((F_{2(0)}*F_{3(I)}*F_{4(0)}*F_{5(I)}*F_{6(0)}*F_{7(I)}) + (F_{2(I)}*F_{3(0)}*F_{4(I)}*F_{5(0)}*F_{6(I)}*F_{7(0)}))$	Z
2	$\Delta R_f (F_2) = (\Delta F_2/7)*$	$2 * ((F_{1(0)}*F_{3(I)}*F_{4(0)}*F_{5(I)}*F_{6(0)}*F_{7(I)}) + (F_{1(I)}*F_{3(0)}*F_{4(I)}*F_{5(0)}*F_{6(I)}*F_{7(0)}))$	Z
3	$\Delta R_f (F_3) = (\Delta F_3/7)*$	$2 * ((F_{1(0)}*F_{2(I)}*F_{4(0)}*F_{5(I)}*F_{6(0)}*F_{7(I)}) + (F_{1(I)}*F_{2(0)}*F_{4(I)}*F_{5(0)}*F_{6(I)}*F_{7(0)}))$	Z
4	$\Delta R_f (F_4) = (\Delta F_4/7)*$	$2 * ((F_{1(0)}*F_{2(I)}*F_{3(0)}*F_{5(I)}*F_{6(0)}*F_{7(I)}) + (F_{1(I)}*F_{2(0)}*F_{3(I)}*F_{5(0)}*F_{6(I)}*F_{7(0)}))$	Z
5	$\Delta R_f (F_5) = (\Delta F_5/7)*$	$2 * ((F_{1(0)}*F_{2(I)}*F_{3(0)}*F_{4(I)}*F_{6(0)}*F_{7(I)}) + (F_{1(I)}*F_{2(0)}*F_{3(I)}*F_{4(0)}*F_{6(I)}*F_{7(0)}))$	Z
6	$\Delta R_f (F_6) = (\Delta F_6/7)*$	$2 * ((F_{1(0)}*F_{2(I)}*F_{3(0)}*F_{4(I)}*F_{5(0)}*F_{7(I)}) + (F_{1(I)}*F_{2(0)}*F_{3(I)}*F_{4(0)}*F_{5(I)}*F_{7(0)}))$	Z
7	$\Delta R_f (F_7) = (\Delta F_7/7)*$	$2 * ((F_{1(0)}*F_{2(I)}*F_{3(0)}*F_{4(I)}*F_{5(0)}*F_{6(I)}) + (F_{1(I)}*F_{2(0)}*F_{3(I)}*F_{4(0)}*F_{5(I)}*F_{6(0)}))$	Z

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6. Findings

Table 04. The result of the author's integral method

№ factor's	Part of formula			
	ΔF_n / n	**Main part of formula (FO_n)**	**Z**	**Final result**
1	$\Delta R_f (F_1) = 0.002857$	1.155910	0.006662	0.009964
2	$\Delta R_f (F_2) = -0.006002$	0.321578	0.006662	0.004732
3	$\Delta R_f (F_3) = 0.004142$	1.406632	0.006662	0.012488
4	$\Delta R_f (F_4) = -0.013690$	0.909610	0.006662	-0.005791
5	$\Delta R_f (F_5) = 0.010890$	0.496339	0.006662	0.012067
6	$\Delta R_f (F_6) = 0.004987$	0.517836	0.006662	0.009244
7	$\Delta R_f (F_7) = 0.006953$	4.405701	0.006662	0.037296
Total	**(ΔF_n / n)*FO_n**		0.046633	**0.08000**
	0.033367			

Factor analysis provides a quantitative assessment of the influence of factor deviations on the deviation of the value of the indicator under study. As can be seen from the final result of tables № 1, № 4, the purpose of the author's method is achieved – the determination of the influence of factors revealed without deviations.

The advantages of the integral method should be recognized as the complete decomposition of factors and the absence of the need to prioritize the action of factors.

A great disadvantage of this method should be recognized as a sharp increase in the complexity of calculations with an increase in the number of factors-factors used in the original model for factor analysis. This method has a significant complexity of calculations, even according to the above formulas, as well as the existence of a fundamental contradiction between the mathematical basis of the method and the nature of economic phenomena.

The study of economic reality is impossible without an analytical approach (Sharpe, 2002). The methods of factor analysis solve the problem of determining the influence of factors on the change of their determined resultant index. The author's integral method of factor analysis determines the applied value of research results aimed at qualitative improvement of the methodology of this type of analysis.

7. Conclusion

The presented author's integral method of factor analysis can be used to calculate the influence of any number of factors that make up the multiplier model.

More detailed economic analysis is the basis for economically sound management of companies. With the help of economic analysis, the following factors are studied:

- trends in the development of companies;
- factors of changes in the results of financial and economic activity of companies are studied deeply and systematically;
- settlement of a variety of plans and management solutions;

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- identified reserves to improve production efficiency;
- economic strategy of the companies is being developed;
- company's performance is evaluated.

Financial profitability is important in today's market environment. This is due to the fact that the management of companies needs to constantly make a number of extraordinary decisions to ensure normal financial stability and profitability. The results of the financial profitability analysis are needed for a wide range of users of management information, both internal users (owners and managers) and external users of management information – creditors, investors, suppliers.

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