Application of integral method in terms of 7-factor multiplicative model

Evgeniy Aleksandrovich Filatov and Antonina Vasilyevna Ryabchenkova

The National Research Irkutsk State Technical University, Lermontov Str., 83, Irkutsk, 664074, Russian Federation

Abstract. In the article the authors presented an alternative approach to determination of integral assessment of impact of factors on generalizing indicator. The author's method of integral factor analysis gives an opportunity to make more comprehensible conclusion about changes in financial state of a company, as well as to evaluate the degree of impact of factors on analyzed indicator variations in the system of management and its change trends. Factor analysis is focused on revealing the impact of certain factors on the productivity indicator. That is why the deterministic modeling of factor systems – is a simple and effective way to formalize the connection of economic indicators that serves as a basis for quantitative evaluation of the role of certain factors in the dynamics of changes in generalizing indicator.

[Filatov E.A., Ryabchenkova A.V. **Application of integral method in terms of 7-factor multiplicative model.** *Life Sci J* 2014;11(9s):227-230] (ISSN:1097-8135). http://www.lifesciencesite.com. 45

Keywords: factor analysis, integral method, deflection, additional growth of the productivity indicator, financial profitability

Introduction

The market-based economy determines specific requirements for the Enterprise Resource Planning system. It is necessary to have a quick response to changes in business situation in order to maintain a sound financial standing and constantly rationalize the production in accordance with market change.

Deterministic factor analysis is focused on detecting the influence of factors, eliminating errors, on the size of the targeted productivity indicator. It is more relevant for practical application in the context of market relations.

Integral method (the method of differential-integral calculus) allows attaining total factorization of productivity indicator and has general character (an additional growth of productivity indicator breaks down due to equal factor interaction regardless of their location in the model), i.e. this method is applied to change the influence of factors in multiplicative, divisible and mixed models of divisible-additive type.

When using the integral method, the aspects of influence of quantitative and qualitative factors were ignored. The influences of factors were considered equal. That is why there is deviation of calculation results regarding the factors as compared to calculations performed through the chain substitution method and the method of absolute and relative differences.

The traditional integral method for multiplicative models is applicable only to two or three factors that are included into the functional model [1-10], where as the author's method can be applied to any number of factors, included into the functional model.

The main goal of the author's integral method of factor analysis (Filatov's method) – is to detect factors that determine the quantity of industry-based supply, i.e. the total change of volume of production from main factors, its components. The main purpose of factor analysis is to get key parameters (the most informative ones) that show an accurate and objective history of changes of volume of production.

Rationally organized information flow and integrated and processed data serves as a basis for model building consistent with goals of analysis.

The modeling of multiplicative factor systems is accomplished by means of consequent breakdown of factors of initial system into cofactors. The functional connection between the productivity indicator and the factors is studied through deterministic factor models. The multiplicative correspondence is used for formalization of integral method. In this correspondence all factors are multiplied together.

The correct interpretation on productivity evaluation can be done under the analysis of interrelation of indicators between each other. That is why in order to characterize an overall performance of a company and an earning capacity of its various business areas (such as production, administration and maintenance, and financial area), profitability margins should be calculated in economic analysis.

Profitability margins are important elements that show the factorial environment of company profit generation. That is why, they are necessary when carrying out a comparative analysis and evaluating a financial condition of a company.

The signal indicator that shows the financial condition of a company is the financial profitability

indicator. The profitability of owned capital, or in other words, financial profitability (R_f) – is the indicator that represents the total net profit / average cost of owned capital ratio. The primary formula for factor analysis appears as follows (Formula 1):

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

Where:

R_f – financial profitability;

ZK – average value of borrowed capital;

SK – average value of owned capital;

SA – asset value;

VA – average value of non-current assets;

OA – average value of floating capital;

SS – cost of products sold (goods, work, and services);

V – total net proceeds from sale of products, work and services (in other words, total proceeds that company receives after tax (VAT, excise duties, and similar binding payments);

P – total net profit (after profit tax, distributable profit);

$F_1 = \frac{ZK}{SK}$ – financial lever arm (financial risk coefficient);

$F_2 = \frac{SA}{ZK}$ – total capital / borrowed capital ratio;

$F_3 = \frac{VA}{SA}$ – immobilized capital share of the total capital stock;

$F_4 = \frac{OA}{VA}$ – floating capital / non-current capital ratio;

$F_5 = \frac{SS}{OA}$ – cost of products / floating assets ratio;

$F_6 = \frac{V}{SS}$ – total net proceeds / cost of sold goods ratio;

$F_7 = \frac{P}{V}$ – profitability of sales.

The basic data for integral factor analysis is presented in the Table 1.

Table 1: The initial data for integral factor analysis

p/p	Indicators	initial factor #	Plan* 0	Fact** I	Deviation*** Δ
1	V – total net proceeds from sale of products, thousand dollars		1150000	1480000	330000
2	SS – cost of products sold, thousand dollars		850000	1050000	200000
3	ZK – average value of borrowed capital, thousand dollars		620000	695000	75000
4	SK – average value of owned capital, thousand dollars		900000	990000	90000
5	VA – average value of non-current assets, thousand dollars		800000	845000	45000
6	OA – average value of current assets, thousand dollars		720000	840000	120000
7	SA – asset value or balance currency, thousand dollars (3 + 4) or (5 + 6)		1520000	1685000	165000
8	P – total net profit, thousand dollars		180000	297000	117000
9	R_f – financial profitability 8/4 = (10 * 11 * 12 * 13 * 14 * 15 * 16)		0,20	0,30	+0,10
10	financial risk coefficient (3/4)	F_1	0,68888889	0,7020202	0,013131313
11	total capital / borrowed capital ratio (7/3)	F_2	2,4516129	2,42446043	-0,027152472
12	immobilized capital share of the total capital stock (5/7)	F_3	0,52631579	0,50148368	-0,02483211
13	floating capital / non-current capital ratio (6/5)	F_4	0,9	0,99408284	0,09408284
14	cost of products / floating assets ratio (2/6)	F_5	1,18055556	1,25	0,069444444
15	total net proceeds / cost of sold goods ratio (1/2)	F_6	1,35294118	1,40952381	0,056582633
16	profitability of sales (8/1)	F_7	0,15652174	0,20067568	0,044153937

where: * **0** – last (base) period (year), taken as a base of comparison; ** **I** – reporting (current) period (year); *** Δ – change for the period, calculated as the difference between fact and plan (**I – 0**).

The combined deflection according to productivity indicator (ΔR_f) can be determined from the Formula 2:

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

Where: the calculation of the influence of factors on change of productivity indicator is presented in Formulas 3.1 – 3.7:

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

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

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

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

$$\Delta R_f\ (F_5) = (\ (\Delta F_5 / n) * (FO_5)\ ) + Z \qquad (3.5)$$

$$\Delta R_f\ (F_6) = (\ (\Delta F_6 / n) * (FO_6)\ ) + Z \qquad (3.6)$$

$$\Delta R_f\ (F_7) = (\ (\Delta F_6 / n) * (FO_7)\ ) + Z \qquad (3.7)$$

Where: additional growth of productivity indicator due to interaction of factors equally between each other (Z) is presented in the Formula 4:

When using the integral method, an additional growth of productivity indicator («irreducible excess» – Z) that appeared as a result of factor interaction, is equally divided between them.

$$Z = \Delta R_f - \sum ((\Delta F_n / n) * (FO_n)) / n \qquad (4)$$

Where: Z – additional growth of productivity indicator due to interaction of factors equally between each other;

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

ΔF_n – certain factor deflection;

n – number of factors participating in analysis.

Where: FO_n – the main part of the formula of author's integral method (Filatov's method) that is calculated from Formulas 5.1 – 5.7:

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

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

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

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

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

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

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

Practical approval of the above-mentioned author's method of integral factor analysis is presented in the Table 3 and 4.

In order to generate of the main part of the formula (FO_n) the principle of factor selection should be used. These factors are presented in the Table 2.

Table 2: Factor selection for the main part of the formula (FO_n) according to the author's method

With the influence of factor #	The sum of multipliers											
	The 1st multiplier						The 2nd 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 calculated from Formula 6:

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

In 7 factor model (**n** = 7), **m** will be 84 (m = 7 * (2*6) = 7 * 12).

For example, when: n = 8, m = 112; n = 9, m = 144; n = 10, m = 180; n = 11, m = 220; n = 12, m = 264 and so on.

Table 3: Constituent parts of the formula according to the author's integral method

# of formula	Constituent parts of the formula		
	$\Delta F_n / n$	Main part of the formula (FO_n)	Z
1	$\Delta R_f(F_1) = (\Delta F_1/7)*$	$2 * (\ (F_{2(I)}*F_{3(I)}*F_{4(0)}*F_{5(I)}*F_{6(0)}*F_{7(I)}) + (F_{2(I)}*F_{3(0)}*F_{4(I)}*F_{5(0)}*F_{6(I)}*F_{7(0)})\ )$	z
2	$\Delta R_f(F_2) = (\Delta F_2/7)*$	$2 * (\ (F_{1(I)}*F_{3(I)}*F_{4(0)}*F_{5(I)}*F_{6(0)}*F_{7(I)}) + (F_{1(I)}*F_{3(0)}*F_{4(I)}*F_{5(0)}*F_{6(I)}*F_{7(0)})\ )$	z
3	$\Delta R_f(F_3) = (\Delta F_3/7)*$	$2 * (\ (F_{1(I)}*F_{2(I)}*F_{4(0)}*F_{5(I)}*F_{6(0)}*F_{7(I)}) + (F_{1(I)}*F_{3(0)}*F_{4(I)}*F_{5(0)}*F_{6(I)}*F_{7(0)})\ )$	z
4	$\Delta R_f(F_4) = (\Delta F_4/7)*$	$2 * (\ (F_{1(I)}*F_{2(I)}*F_{3(0)}*F_{5(I)}*F_{6(0)}*F_{7(I)}) + (F_{1(I)}*F_{3(0)}*F_{3(I)}*F_{5(0)}*F_{6(I)}*F_{7(0)})\ )$	z
5	$\Delta R_f(F_5) = (\Delta F_5/7)*$	$2 * (\ (F_{1(I)}*F_{2(I)}*F_{3(0)}*F_{4(I)}*F_{6(0)}*F_{7(I)}) + (F_{1(I)}*F_{3(0)}*F_{3(I)}*F_{4(0)}*F_{6(I)}*F_{7(0)})\ )$	z
6	$\Delta R_f(F_6) = (\Delta F_6/7)*$	$2 * (\ (F_{1(I)}*F_{2(I)}*F_{3(0)}*F_{4(I)}*F_{5(0)}*F_{7(I)}) + (F_{1(I)}*F_{3(0)}*F_{3(I)}*F_{4(0)}*F_{5(0)}*F_{7(0)})\ )$	z
7	$\Delta R_f(F_7) = (\Delta F_7/7)*$	$2 * (\ (F_{1(I)}*F_{2(I)}*F_{3(0)}*F_{4(I)}*F_{5(0)}*F_{6(I)}) + (F_{1(I)}*F_{3(0)}*F_{3(I)}*F_{4(0)}*F_{5(I)}*F_{6(0)})\ )$	z

The factor analysis provides an opportunity to get quantitative evaluation of the influence of factor deflections on the deflection of analyzed indicator. As is seen from the conclusive result of tables 1 and 4, the goal of the author's method has been achieved – the influence of factors has been unraveled without deflection.

Advantages of integral method are the complete decomposition of factors and the absence of necessity to determine the priority of factor functioning.

A big disadvantage of this method is the heavy increase in complexity of calculation, when the number of cofactors-multipliers, which are used in the basic model of factor analysis, increases. This method has a significant computational complexity even when using formulas given above. There is also a fundamental contradiction between the mathematical framework of the method and the nature of economic phenomena.

Table 4: The result according to the author's integral method

# of factor	Constituent parts of the formula			
	ΔF_n / n	Main part of the formula (FO_n)	Z	Conclusive result
1	$\Delta R_f(F_1)$ = 0,001875902	1,081426034	0,007958209	0,009986858
2	$\Delta R_f(F_2)$ = -0,003878925	0,306703507	0,007958209	0,006768530
3	$\Delta R_f(F_3)$ = -0,003547444	1,465895260	0,007958209	0,002758028
4	$\Delta R_f(F_4)$ = 0,013440406	0,821454125	0,007958209	0,018998886
5	$\Delta R_f(F_5)$ = 0,009920635	0,645875919	0,007958209	0,014365709
6	$\Delta R_f(F_6)$ = 0,008083233	0,566021688	0,007958209	0,012533495
7	$\Delta R_f(F_7)$ = 0,006307705	4,221865943	0,007958209	0,034588495
Only	$(\Delta F_n / n)^* FO_n$		0,055707465	**0,100000000**
	9,109242477			

The study of economic reality is impossible without the analytical approach. The author's deterministic factor analysis is aimed to solve a problem of search of influence values of factor changes on the change in resulting indicator. This determines the applied significance of research results, aimed at qualitative improvement of methodology of this type of analysis.

The author's integral method (Filatov's method) aimed at qualitative improvement of the methodology of this kind of analysis, and the advent of the calculation of the effect of any number of factors used in the original model for the analysis.

The financial profitability ratio is of great importance in the modern competitive business environment, when the company's management team has to constantly make unusual decisions to ensure the profitability, and therefore, the financial stability of a company. The results of analysis of financial profitability are necessary primarily for owners, as well as for creditors, investors, suppliers and managers. [11-16]

Corresponding Author:
Dr.Filatov Evgeniy Aleksandrovich
The National Research Irkutsk State Technical University, Lermontov Str., 83, Irkutsk, 664074, Russian Federation.

References

1. Economic analysis, 2011. Moscow: INFRA-M, 320 p.
2. Economic analysis, 2001. Moscow: UNITY-DANA, 527 p.
3. Economic analysis: Course book for universities, 2002. Moscow: UNITY-DANA, 615 p.
4. Voytolovsky, N.V., et al., 2011. Economic analysis: Theoretical framework. The complex analysis of business activity of organization: Course book. Moscow: ID YURAYT, 507 p.
5. Ionova, U.G., et al, 2012. Economic analysis: Course book Moscow: Moscow Academy of Finance and Industry, 426 p.
6. Endovitsky, D.A., A.N. Isaenko, V.A. Lubkov, N.V. Zhuravleva, et al., 2009. Economic analysis of active assets of the company: Coursebook. Moscow: Eksmo, 608 p.
7. Economic analysis ofperformance of companies and associations, 1981. Moscow: Finance and Statistics, 488 p.
8. Economic analysis in commerce: Study guide, 2004. Moscow: Finance and Statistics, 220 p.
9. Economic analysis: Theoretical framework. The complex analysis of business activity of organization: Course book, 2006. Moscow: Visshee Obrazovanie, 513 p.
10. Economic analysis: situations, tests, problems, optimization, financial forecasting: Study guide, 2000. Moscow: Finance and Statistics, 656 p.
11. Matteucci, M., 1957. Introduction a l'etude systematique du droit uniforme. RCADL Leiden, 1(91): 388.
12. Davies, I., 2003. The new lex mercatoria: International interests in mobile equipment. International and Comparative Law Quarterly, 52: 153.
13. Filatov, E.A., 2013. Factor analysis of equity capital profitability by author's methods. Bulletin of ISTU, 6 (77): 234 – 240.
14. Filatov, E.A. and V.B. Nechayev, 2013. Functional analysis of financial profitability. Bulletin of ISTU, 12 (83).
15. Filatov, E.A. and I.G. Dykusova, 2013. Deterministic factor analysis of innovative company's profitability. Proceedings of the ISEA (BSUEL): online journal, 5.
16. Filatov, E.A., 2013. Author's factor analysis of financial profitability. European Social Science Journal, 8 (35). Volume 2: 462 – 471.

5/29/2014