

## Relevant Approaches to Performing Analysis of Financial Results of Organization's Activity with Application of Factor Models

Alexey N. Kirpikov and Fatih Sh. Nugaev  
Kazan Federal University, 420008 Kazan, Russia

---

**Abstract:** In this research, we provided detailed justification of application of factor analysis tools in the process of economic diagnostics of financial results of company's operational activity. The focus of research was on scientific discussion of computational algorithms of factor analysis of company's marginal profit. Generalization of digital data arrays allowed reflecting particular peculiarities of application of alternative factor models, to demonstrate the process of numeric measurement of factor attributes' influence at resulting index, to suggest approaches to interpretation of economic sense of analyzed factors. Polemical character of analyzed methodic approaches formed a basis of systematization of complex of backgrounds and objective limitations of their situational application. Necessity of further specification of primary diagnostics' results of changes in company's joint marginal profit, obtained with application of factor models, defined the feasibility of development of multidimensional rating algorithm for analysis of sales efficiency at the level of separate types of products.

**Key words:** Analysis of sales efficiency, factor models of financial analysis, analysis of marginal profit, algorithm, index

---

### INTRODUCTION

Generalization of approaches to economic analysis of current financial results, provided in specialized literary sources, allows concluding that significant perspectives of successful application in financial management system belong to methods of determined factor analysis of organization's profit indicators. Possibility of quantitative measurement of factor attributes' impact on resulting index is not only creating the base for effective monitoring of negative and positive aspects of financial and business activity of the company but also represents informational base for successful administration of its business processes. The object of factor analysis may become any profit index, formed in accounting information system; however, in practice a preference is given to financial results from sales. It should be noted that results of company's operational activity are established under influence of economic conditions which form during several reporting periods and, as a rule, they have a trend component which allows taking results of factor analysis as a base for correcting policy of company management and sales for the short term.

### MATERIALS AND METHODS

It is safe to say that methodic mechanism of establishment and quantitative measurement of power of

cause and effect relationship between factor attributes and resulting indices has been a subject of fundamental researches in various scientific fields for a long period. Formalized interpretation of the method was described in details yet in the researches that were published in the seventies of the previous century (Harry, 1976; Jaeon and Charles, 1978). Multidimensionality in manifestation of stochastic interconnections, along with complexity of their mathematical processing, defined the need in searching ways of advancing factor analysis algorithms (Anderson, 2003; Timothy, 2006; James, 2009; Kapetanios, 2004). Considerable achievements in development of modern approaches to building factor models became the base for their integration into basis methodic algorithms of corporative financial analysis, analyzed in specialized academic publications.

Significant potential of application of factor models was unlocked in financial management at justification of investment solutions (Frank *et al.*, 2006). At the same time, the process of scientific discussion of factor analysis' application, aimed at overcoming of occurring contradictions on the way of its situational application (Erdogan, 2013; Filatov and Nechaev, 2014; Filatov and Rudykh, 2014). Generalization of the main content of abovementioned sources formed the base of researchars suggestions for the usage of alternative variants of performing factor analysis of financial results of company's activity which were presented in this study.

Table 1: Initial data for performing factor analysis

The name of the product	Amount of products sold (Q <sub>i</sub> ), items		Ratio of products sold (T <sub>i</sub> )		Marginal profit from 1 item (MR <sub>i</sub> ), USD	
	2013 (Q <sub>0</sub> )	2014 (Q <sub>1</sub> )	2013 (T <sub>0</sub> )	2014 (T <sub>1</sub> )	2013 (MR <sub>0</sub> )	2014 (MR <sub>1</sub> )
A	25,000	22,500	0.2639916	0.2210216	280	275
B	16,000	18,900	0.1689546	0.1856582	220	248
C	20,000	21,000	0.2111932	0.2062868	315	275
D	19,200	25,000	0.2027455	0.2455796	326	374
E	14,500	14,400	0.1531151	0.1414538	357	405
Total	94,700	101,800	1	1	x	x

**RESULTS AND DISCUSSION**

Investigating methodic approaches to factor analysis of sales efficiency indices with the usage of proprietary information of current record, we state that necessity of extensive scientific discussion of applied computational algorithms is mostly present in the part of factor analysis of organization’s marginal profit.

In practice of economic work of business entities, multiplicative factor model of marginal profit changes has been applied:

$$AMR = \sum_{i=1}^n Q_i \times T_i \times MR_i \tag{1}$$

Where:

- AMR = A joint marginal income from sales (USD)
- Q<sub>i</sub> = A sale volume of i typed products in physical terms, items
- T<sub>i</sub> = The ratio of sales of i typed products in joint physical volume of sales
- MR<sub>i</sub> = The marginal profit from sales of item of i typed products (USD)

Initial information, necessary for application of the mentioned model, is systematized in Table 1. Traditional approach to performance of factor analysis, which implies sequential elimination of factors, allows numerically measure influence of each of them onto resulting index. Computational algorithm of finding the influence of the factors that are included into investigated model and that forms a part of methodic base of its application, is presented in Table 2.

For generalization of results of performed calculations, it is convenient to use Table 3, in which changes of sizes of factorial attribute is combined with assessment of its level of impact in resulting index.

Influence of volume factor (ΣQ<sub>i</sub>) is generally, associated with changes in joint volume of the market of all sold goods items which may be caused by both economic conditions and intercompany processes, initiated as a part of business administration procedures.

Table 2: Methodical algorithm of finding factors’ influence at changes

Influencing factors	Computational algorithm
The quality of products sold	$\Delta AMR \left[ \Delta \sum_n^{i=1} [Q_i] = \left( \sum_n^{i=1} Q_{i_1} - \sum_n^{i=1} Q_{i_0} \right) \right] T_{i_0} \times MR_{i_0}$
Structure of sales	$\Delta AMR (\Delta T_i) = \sum_n^{i=1} Q_{i_1} \times (T_{i_1} - T_{i_0}) MR_{i_0}$
Marginal profit for product item	$\Delta AMR (\Delta MR_{i_1}) = \sum_n^{i=1} Q_{i_1} \times T_{i_1} (MR_{i_1} - MR_{i_0})$

Changes in structure of sales (T<sub>i</sub>) require even more detailed consideration, since increase of volumes of products’ sales which have lower indices of marginal profit for one item, may blunt the sales effectiveness according to criterion of joint marginal profit and, thus, should be an object of constant financial monitoring. Index of marginal profit for one item of goods (MR<sub>i</sub>) is endowed with a profound economic content, positive impact of growing marginal profit on goods item which is not accompanied with decrease in joint volume of sales and negative structural changes, in conditions of growing market may be a sequence of favorable outer environment of organization; however, in conditions of modern economic circumstances it more often speaks of rational policy of company’s price formation and demonstrable characterizes results of effective managerial impact.

Data from Table 3 shows that in studied example growth of joint marginal profit happens in conditions of increasing of natural sales volume which happens without substantial structural changes, which reflects stable market’s condition, where studied organization is positioned as well as rational character of selected financial policy. The reasons of changes in marginal profit for one item of product for particular nomenclature positions require more detailed study. At the same time, it is obvious that key driver of growth is increase of resulting index per item D while other product types demonstrate heterogeneous dynamics.

Significant economic sense of performing analytical calculations with application of abovementioned factor model does not free it from substantial defects that

Table 3: Results of factor analysis of joint marginal approach

The name of the product	Changes of factors			Influence of changes of factors (USD)			
	Q <sub>i</sub> шт.	T <sub>i</sub>	MR <sub>i</sub> (USD)	ΔMR <sub>(ΔQ)</sub>	ΔMR <sub>(ΔT)</sub>	ΔMR <sub>(ΔMR<sub>i</sub>)</sub>	ΔMR (USD)
A	-2,500	-0,042970	-5	524,815	-1 224 815	-112,500	-812,500
B	2,900	0,016704	28	263,907	374 093	529,200	1167,200
C	1,000	-0,00491	-40	472,334	-157 334	-840,000	-525,000
D	5,800	0,042834	48	469,275	1 421 525	1,200,000	3090,800
E	-100	-0,01166	48	388,101	-423 801	691,200	655,500
Total:	7,100	x	x	2,118,432	-10 332	1,467,900	3,576,000

Table 4: Initial data for performing factor analysis

The name of the product	Revenues from sales (R <sub>i</sub> ) thousands of USD		Ratio of products sold per revenue (T <sub>i</sub> )		Level of marginal profit (AMG <sub>i</sub> ) USD	
	2013 Γ (Q <sub>0</sub> )	2014 Γ (Q <sub>1</sub> )	2013 Γ (T <sub>0</sub> )	2014 Γ (T <sub>1</sub> )	2013 Γ (AMG <sub>0</sub> )	2014 Γ (AMG <sub>1</sub> )
A	20,000	18,900	0,2602134	0,2240797	0,350	0,327
B	11,200	13,419	0,1457195	0,1590966	0,314	0,349
C	16,400	15,960	0,213375	0,1892228	0,384	0,362
D	18,240	23,250	0,2373146	0,2756536	0,343	0,402
E	11,020	12,816	0,1433776	0,1519474	0,470	0,455
Total	76,860	84,345	1	1	x	x

impede active usage of studied methodic algorithms. Key obstacle on the path of universal practical application of studied approach is the necessity of generalization of studied assortment sales group within the framework of unified natural measuring instrument which implies sales of series (homotypic) production, goods and services. On the other hand, non-homogeneity of products issue in most cases is not an insurmountable obstacle for efficient usage of factor model, since natural sales volumes may be stratified according to goods' types which have unified natural measurer.

In these conditions, a relevant alternative to applied algorithm is a transformation of abovementioned factor model which implies refusal of natural measurers of sales volumes in favor of cost parameters of profit. Transformed factor model looks in the following way:

$$AMR = \sum_{i=1}^n R_i \times T_i \times AMG_i \quad (2)$$

Where:

- AMR = The joint marginal profit from products sales (USD)
- R<sub>i</sub> = The revenues from sales of ityped products (USD)
- T<sub>i</sub> = The ratio of products sales of ityped products in joint total value of sales
- AMG<sub>i</sub> = The marginal profit from sales of ityped products per 1 ruble of revenues from sales of ityped products (USD)

For performing factor analysis one needs to group initial data array in Table 4. The mechanism of defining factors' influence in modified factor model, presented in

Table 5: Methodic algorithm of defining factors' influence

Influencing factor	Calculation algorithm
Revenues from sales	$\Delta AMR \left( \Delta \sum_n^{i=1} R_i \right) = \left( \sum_n^{i=1} R_{i1} - \sum_n^{i=1} R_{i0} \right) \times T_{i0} \times AMG_{i0}$
Structure of sales	$\Delta AMG (\Delta T_i) = \sum_n^{i=1} R_i \times (T_{i1} - T_{i0}) \times AMG_{i0}$
Marginal profit for product item	$\Delta AMR (\Delta AMG_i) = \sum_n^{i=1} R_i \times T_{i1} \times (AMG_{i1} - AMG_{i0})$

Table 5 does not have fundamental distinctions from earlier described approach and, like in the previous case, it implies assessment of separate influence of factors on resulting level.

An obvious advantage of transformed model is the fact that company's management may on their own initiative choose the perimeter of analyzed aggregation and include goods form one commodity group into it or generalize information about revenues and the level of marginal profit from sales per various groups of sold products. It is obvious that results of the analysis, obtained with application of alternative factor models, would be different.

Data from Table 6, which integrate results of performed calculations shows that transformation of factors' composition in the model changed quantitative results of the analysis, however, it didn't cause significant influence on economic interpretation of the reasons of changes in joint marginal profit of the company.

Increase of revenues from sales of studied company is observed not at all goods items; however, absence of significant structural changes allows confirming stability

Table 6: Results of factor analysis of joint marginal profit

The name of the product	Change of factors			Influence of change of factors (USD)			
	R <sub>i</sub> (USD)	T <sub>i</sub>	AMG <sub>i</sub> (USD)	ΔMR <sub>(ΔR)</sub>	ΔMR <sub>(ΔT)</sub>	ΔMR <sub>(ΔAMG<sub>i</sub>)</sub>	ΔMR (USD)
A	-1,100	-0,03613	-0,023	681,694	-1 066,694	-427,500	-812,500
B	2,219	0,01338	0,035	342,795	354,605	469,800	1 167,200
C	-440	-0,02415	-0,022	613,525	-782 549	-355,976	-525,000
D	5,010	0,03834	0,059	609,551	1,109,670	1 371,579	3,090,800
E	1,796	0,00857	-0,015	504,113	339,535	-188,147	655,500
Total	7 485	x	x	2,751,677	-45,433	869,756	3,576,000

Table 7: Calculation of rating of sales efficiency of separate product types, per index of marginal profit

Type of product	Criterion			MR <sub>i</sub> /MR <sub>max</sub>	AMG <sub>i</sub> /AMG <sub>max</sub>	AMR <sub>i</sub> /AMR <sub>max</sub>	K <sub>1</sub> ×MR <sub>i</sub> /MR <sub>max</sub>	K <sub>2</sub> ×AMG <sub>i</sub> /AMG <sub>max</sub>	K <sub>2</sub> ×AMR <sub>i</sub> /AMR <sub>max</sub>	CR
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>							
A	275	0.327	6,187,500	0.68	0.72	0.66	0.543	0.229	0.794	1.566
B	248	0.349	4,687,200	0.61	0.77	0.50	0.490	0.245	0.602	1.336
C	275	0.362	5,775,000	0.68	0.80	0.62	0.543	0.253	0.741	1.538
D	374	0.402	9,350,000	0.92	0.88	1.00	0.739	0.280	0.200	2.220
E	405	0.455	5,832,000	1.00	1.00	0.62	0.800	0.319	0.748	1.867

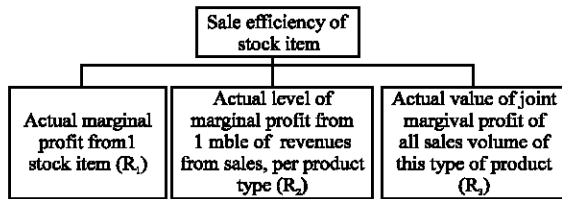


Fig. 1: Criteria of rating scores of sales' efficiency at the level of product types

of sales policy and acceptable level of risk of substantial worsening of market conditions in the short term. The level of marginal profit generally, causes positive influence at resulting index, however, we should note that item D demonstrates evident positive dynamics which compensates decrease in efficiency per other summands of sales assortment.

In spite of evident grounds for wider application of modified factor model, it should not be considered as fully free from defects. It should be noted that switch to cost measurement of sales volume makes interpretation of influence of sold products' actual amount more difficult while the index of marginal profit may be perceived by the users of analysis' results as less informative incomparision with absolute value of marginal profit per item of products.

On the other hand, it is reasonable to consider presented factor models as means of primary diagnostics of direction of basic factors' action which influence changes of organization's joint marginal profit. At the same time, in the process of financial management of sales, paramount importance belongs to definition of goods items which cause the most significant influence in total results of sales and their changes in time. Within the context of searching ways to solve the task set, we consider, it reasonable to range types of products sold according to criteria, provided in Fig. 1.

Setting priorities of industrial and sales policies, the company may use traditional algorithm of comparative analysis. At the same time, one needs to consider that for advancement of effective application of complex assessment of goods item one may use various weighing coefficients which allow varying significance of separate criteria at formation of overall ranking. In particular, a preference may be given to actual value of joint marginal profit of all sales volume of this product type, sine this is the index that most substantively reflects an input of particular item into total results of operational activity.

Formalization of algorithm of complex assessment of sales' efficiency of nomenclature position may be presented in the following way:

$$CR = K_1 \times \frac{MR_i}{MR_{max+k_2}} \times \frac{AMG_i}{AMG_{max+k_2}} \times \frac{AMR_i}{AMR_{max}} \quad (2)$$

Let us state values for weighing coefficients K<sub>1,3</sub> at the level of 0.8; 0.7; 1.2 correspondingly and let us systematize results of calculations in the view of block scheme, presented below at Table 7 Performed calculations indicate that item D occupies leading position it overall rating of sales efficient which has a maximal level of marginal profit and follows item E in terms of absolute indicators of marginal profit per one goods item and joint sales volume.

**Summary:** Results of investigation of situational application of factor analysis tools of financial sales results in economic science and business practice provide evidence of significant potential of usage of observed methodic approaches at performing intracompany monitoring of profit and sales revenue values. Obtainment of detailed information about direction and power of

influence on resulting index forms basis for interpretation of company's management of main tendencies that define efficiency of company's operational activity and it favors effective business administration.

### **CONCLUSION**

Results of the research, we performed allowed us justifying practicability of application of methodic tools of factor analysis in the process of economic diagnostics of financial results of organization's operational activity, reflecting particular peculiarities of application of alternative factor models, demonstrating the process of quantitative measurement of fact attributes' impact on resulting index, suggesting approaches to interpretation of economic sense of analyzed factors. Polemical character of studied methodic approaches formed the basis of systematization of preconditions and objective limitations of their situational application. In this research, we suggested an algorithm of multidimensional rating analysis of sales efficiency at the level of separate nomenclature positions of the products sold.

### **ACKNOWLEDGEMENT**

The research is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

### **REFERENCES**

- Anderson, T.W., 2003. An Introduction to Multivariate Statistical Analysis, 3rd Edn. Wiley Series in Probability and Statistics. NJ.: Wiley-Interscience, John Wiley and Sons.
- Erdogan, A.I., 2013. Applying Factor Analysis on the Financial Ratios of Turkey's Top 500 Industrial Enterprises. *Intl. J. Busin. and Manage.*, 8 (9): 134-139.
- Filatov, E.A. and V.B. Nechaev, 2014. Problem-solving in deterministic factor analysis. *Middle-East J. Scient. Res.*, 5: 723-728.
- Filatov, E.A. and L.G. Rudykh, 2014. Factor analysis of financial profitability according to the author's methods. *World Appl. Sci. J.*, (7), pp: 908-914.
- Frank, J.F., M.F. Sergio, N.K. Petter, 2006. Financial Modeling of the Equity Market: from CAPM to Cointegration. Wiley, Hoboken, New Jersey.
- Harry, H.H., 1976. Modern Factor Analysis. 3rd Edn., Chicago University of Chicago Press.
- Kapetanios, G., 2004. A new method for determining the number of factors in factor models with large datasets. Queen Mary University of London, No. 525.
- James, P.S., 2009. Applied Multivariate statistics for the Social Science. N.J.: Taylor and Francis Group LLC.
- Jaeon, K. and W.M. Charles, 1978. Factor analysis: statistical methods and practical issues. Sage University Paper Series on Quantitative Application in the Social Sci., Newbury Park, CA: Sage, pp: 07-014.
- Timothy, A.B., 2006. Confirmatory factor analysis for applied research. Guilford Press.