Author's integrated methods of analysis of the model of return on assets of construction companies

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Abstract. The author has proposed a method of managing the return on assets of construction companies through the decomposition of the return on assets factors that reflect various aspects of the company. The author's model of return on assets of construction companies allows you to determine the factors due to which there was a change in profitability or to make a factor analysis of profitability. The article presents 2 author's methods of integral analysis. The author's methods of integral factor analysis complement the process of knowledge of the functioning of economic systems, revealing the existing economic laws and objectively existing cause-and-effect relationships between the phenomena of economic life. 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 management function that provides scientific decision – making. Article executed within the framework of a research project of ISC SB RAS № XI.174.1.4 «Activation of internal potential of resource specialization regions development (on the example of the Baikal region)». 
1 Introduction

To characterize the efficiency of the construction company as a whole, the profitability of various activities (economic, financial, business) in the economic analysis, the profitability indicators are calculated (Pugaev, A. V., 2013).

One of the key performance indicators of the company is the overall return on assets (Abdukarkinov, I. T., 2013; Ivanov, I. N., 2013; Kazakova, N. A., 2014). Return on assets – the most important indicator of the efficiency of a commercial organization, the basic standard or the average value in the market economy, with which the individual indicators of enterprises are correlated to justify their competitiveness (Kashkin, S. Yu., 2012; Kireeva, N. V., 2013; Kogdenko, G. V., 2015).

2 Research questions

Any process develops under the influence of various factors. Knowledge of these factors and the ability to manage them allows you to influence the change in performance indicators of the enterprise (Enyukov, I. S., 2008; Kazakova, N. A., 2013; Turmanidze, T. U., 2011).

The author's model of return on assets of construction companies is a modified factor analysis to determine the factors due to which there was a change in profitability. The factor model in the form of a tree structure is based on the return on assets (ROA) indicator, and the signs are the characterizing factors of the enterprise activity. Simply put, factors that affect ROA are broken down to determine which factors affect return on assets to a greater or lesser extent. Three main factors:

1. return on equity (this ratio is calculated as the ratio of net profit to equity);
2. the coefficient of income coverage by equity introduced by the author (this coefficient is calculated as the ratio of equity to net revenue from all types of sales);
3. asset turnover (asset turnover ratio or total capital return is calculated as the ratio of revenue from all sales to total assets).

Return on equity, return on equity ratio and asset turnover characterize simultaneously three types of activities of the company:
- investment;
- financial;
- operating.
The difference between return on assets (ROA) and return on equity (ROE) is that ROA shows the effectiveness of all assets of the enterprise, and ROE only those that belong to the owners.

The advantage of the Filatov model is the «splitting» of complex indicators into factors that make up them. This allows us to determine the root causes and the relationship of changes in complex performance indicators of the company. With the help of the factor analysis scheme of key indicators, it is possible to clearly trace the influence of primary factors on the formation of complex indicators, to give their comparative characteristics and determine the reasons for their change (Filatov, E. A., 2018).

3 Materials and methods

The object of the study is the joint stock company financial and construction company «New city» created in November 1996. The financial and construction company «New city» conducts complex building of houses in Irkutsk. For 21 years «New city» built and commissioned more than 644 thousand square meters of housing.

The sources of the information base on the financial results of the joint stock company «New city» were the financial statements: Balance sheet as of December 31, 2017; Report on financial results for 2017.

The initial data for the integral factor analysis for 3 factors are presented in table 1.

Table 1. Initial data for factor analysis of the three-factor model.

| No. | Indicators                      | 2016 year (0) * | 2017 year (I) ** | Deviation (Δ) *** |
|-----|---------------------------------|----------------|------------------|-------------------|
| 1   | V – Revenue from sales, thousand rubles | 220 541 | 111 735          | -108 806          |
| 2   | P – Net profit, thousand rubles  | 14 125         | 19 193           | 5 068             |
| 3   | A – Total assets, thousand rubles | 3 068          | 4 716            | 1 647 763         |
| 4   | SK – Own capital, thousand rubles | 464            | 227              | 264 192           |
| 5   | ROA – Return On Assets          | 0.00460        | 0.00406          | -0.000534         |
2/3 = (6 * 7 * 8)

|    | ROE – Return On Equity (2/4) |    | EICR – Equity Income Coverage Ratio (4/1) |    | AT – Asset Turnover (1/3) |
|----|-------------------------------|----|------------------------------------------|----|--------------------------|
| 6  | F1                            | 0  | F2                                       | 9  | F3                        |
|    | 0.06751                       | 0.04054 | 0.94869                               | 4.23698 | 0.07187                  | 0.02369 |
|    | 1                             | -0.026969 | 0                                      | 3.288281 | 2                          | -0.048182 |

where: * 0 - past (basic) period (year), taken as reference base; ** I – reported (current) period (year); *** Δ – change for the period, calculated as the difference between the fact and the plan (I – 0).

For the formalization of the integral method, a multiplicative dependence is chosen – this is a dependence in which all factors multiply among themselves. In this case, the initial formula for factor analysis will be as follows (formula 1):

\[
ROA = ROE \times EICR \times AT = F1 \times F2 \times F3 = \prod_{n=1}^{3} F_n \tag{1}
\]

The total deviation of the resulting indicator (\(\Delta ROA\)) is determined by the formula 2:

\[
\Delta ROA = \sum_{n=1}^{3} \Delta ROA(F_n) = \Delta ROA(F1) + \Delta ROA(F2) + \Delta ROA(F3) \tag{2}
\]

Below we present 2 authors integral methods of factor analysis.

The calculation of the influence of factors on the change in the effective indicator (\(\Delta ROA\)) is presented by method No. 1 for 3 factors in formulas 3.1–3.3:

\[
\Delta ROA (F_1) = (\Delta F_1 / n) \times (FONe1_1) + ZNe1 \tag{3.1}
\]

\[
\Delta ROA (F_2) = (\Delta F_2 / n) \times (FONe1_2) + ZNe1 \tag{3.2}
\]

\[
\Delta ROA (F_3) = (\Delta F_3 / n) \times (FONe1_3) + ZNe1 \tag{3.3}
\]

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

When using the author’s integral method, an additional increase in the effective indicator («indecomposable residue» – Z), formed as a result of the interaction of factors, is distributed equally between them.
where: Z – additional growth of the effective indicator due to the interaction of factors equally between them;  
FON&_1_n – the main part of the formula of the author's integral method №1;  
\( \Delta F_n \) – deviation by a certain factor;  
n – is the number of factors involved in the analysis.

where: FON&_1_n – the main part of the formula of the author's integral method No. 1 is calculated by formulas 5.1–5.3:

\[
\begin{align*}
FON_1 &= 2 \ast ( (F_{20} \ast F_{30}) + (F_{20} \ast F_{30}) ) \\
FON_2 &= 2 \ast ( (F_{10} \ast F_{30}) + (F_{10} \ast F_{30}) ) \\
FON_3 &= 2 \ast ( (F_{10} \ast F_{20}) + (F_{10} \ast F_{20}) )
\end{align*}
\] (5.1–5.3)

Approbation of the author's integral method No. 1 presented above is presented in tables No. 3, 4.

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

Table 2. Selection of factors for the main part of the formula (FOn) by the author's integral methods.

| Under influence No. factors | the sum of the factors |
|-----------------------------|-----------------------|
|                            | The 1st factor | The 2nd factor |
| 0                          | 1               | 1               | 0               |
| 1                          | 2               | 3               | 2               | 3               |
| 2                          | 1               | 3               | 1               | 3               |
| 3                          | 1               | 2               | 1               | 2               |

where: \( m \) – the number of indicators in the main part of the formula (table. 2). \( m \) is defined by the formula 6:

\[
m = n \ast (2\ast(n - 1))
\] (6)

With 4 factors in the model (\( n = 3 \)), \( m \) will be 12 (\( m = 3 \ast (2\ast2) = 3 \ast 4 \)).

When: \( n = 10, m = 180, n = 20, m = 760, \) etc.

Table 3. Components of the formula according to the author's integral method No. 1.

| No. | part of the formula |
|-----|---------------------|

5
The calculation of the influence of factors on the change of the effective indicator in the author's integral method No. 2 is presented in formulas 7.1–7.3:

\[
\Delta \text{ROA} (F_1) = (\Delta F_1 \ast \text{FO}_1) + Z \text{N}_2 \\
\Delta \text{ROA} (F_2) = (\Delta F_2 \ast \text{FO}_2) + Z \text{N}_2 \\
\Delta \text{ROA} (F_3) = (\Delta F_3 \ast \text{FO}_3) + Z \text{N}_2
\]

When using the traditional integral method, the additional increase in the effective indicator («indecomposable residue» – Z), formed as a result of the interaction of factors, is distributed equally between them (formula 8).

\[
Z \text{N}_2 = \Delta \text{ROA} - \sum ((\Delta F_n \ast \text{FO}_n) / n
\]

where: \(\text{FO}_n\) – the main part of the formula of the author's integral method is calculated by formulas 9.1–9.3:

\[
\text{FO}_1 = ( (F_{20} \ast F_{30}) + (F_{20} \ast F_{30}) ) / 2 \\
\text{FO}_2 = ( (F_{10} \ast F_{30}) + (F_{10} \ast F_{30}) ) / 2 \\
\text{FO}_3 = ( (F_{10} \ast F_{20}) + (F_{10} \ast F_{20}) ) / 2
\]
To form the main part of the formula (FON№2), it is necessary to use the principle of choosing the factors disclosed in table № 2.

The approbation of the author's method of factor integral analysis No. 2 presented above is presented in tables No. 5, 6.

Table 5. Components of the formula according to the author's integral method No. 2.

| No. formulae | $\Delta F_n$ | part of the formula | the main part of the formula $(FON№2)$ | $Z$ |
|--------------|--------------|---------------------|----------------------------------------|-----|
| 1            | $\Delta ROA (F_1) = \Delta F_1$ * $\frac{((F_2(0)* F_3(I)) + (F_2(I)* F_3(0)) )}{2}$ | $Z$ |
| 2            | $\Delta ROA (F_2) = \Delta F_2$ * $\frac{((F_1(0)* F_3(I)) + (F_1(I)* F_3(0)) )}{2}$ | $Z$ |
| 3            | $\Delta ROA (F_3) = \Delta F_3$ * $\frac{((F_1(0)* F_2(I)) + (F_1(I)* F_2(0)) )}{2}$ | $Z$ |

Table 6. the Result of the author's integral method No. 2.

| No. factor's | $\Delta F_n$ | the main part of the formula $(FON№2)$ | $Z№2$ | Final result |
|--------------|--------------|----------------------------------------|------|--------------|
| 1            | $\Delta ROA (F_1) = -0.026969$ | 0.163501 | 0.001424 | -0.002985 |
| 2            | $\Delta ROA (F_2) = 3.288281$ | 0.002257 | 0.001424 | 0.008844 |
| 3            | $\Delta ROA (F_3) = -0.048182$ | 0.162251 | 0.001424 | -0.006393 |
| Hroro        | -0.004807    | 0.004273 | -0.000534 |

Factor analysis allows to obtain a quantitative assessment of the influence of deviations of factors on the deviation of the value of the studied indicator. As can be seen from the final result of tables No. 1, No. 4, No. 6 the purpose of the author's methods is achieved – the determination of the influence of factors is disclosed without deviations.

4 Results

Let us compare the results obtained by the author's integral methods on 3 factors with each other (table 7).
Table 7. Comparison of results by the author's integral method.

| Indicator | Result No. 1 | Result No. 2 | Δ |
|-----------|--------------|--------------|---|
| Δ ROA (F₁) | -0.001237 | -0.002985 | 0.001748 |
| Δ ROA (F₂) | 0.008604  | 0.008844 | -0.000240 |
| Δ ROA (F₃) | -0.007901 | -0.006393 | -0.001508 |
| Δ ROA     | -0.000534 | -0.000534 | 0      |

Let us compare the results obtained by the author's integral methods on 3 factors with non-integral methods (table 8).

Table 8. Results on the author's integral method in comparison with it by integral methods.

| Indicator | Integral No. 1 | Integral No. 2 | Not integral methods | Δ Δ |
|-----------|----------------|----------------|----------------------|-----|
|           | Δ ROA (F₁)    |                |                      |     |
|           | 0.001237      | 0.002985       |                      | 0.001839 Δ |
|           | Δ ROA (F₂)    |                |                      |     |
|           | 0.008604      | 0.008844       |                      | -0.000978 Δ |
|           | Δ ROA (F₃)    |                |                      |     |
|           | 0.007901      | 0.006393       |                      | 0.000375 Δ |
|           | Δ ROA         |                |                      |     |
|           | 0.000534      | 0.000534       |                      | 0    |

Based on the data in table 9, it can be seen that the «indecomposable residue» – Z is much higher in the author's method No. 1, so it is more advisable to use the method No. 2 in practice.

Table 9. Z on the author's integral methods in the given author's models.

| Indicator | Z№1 | Z№2 |
|-----------|-----|-----|
| F₁        | 0.001905 | 0.001424 |
| F₂        | 0.001905 | 0.001424 |
| F₃        | 0.001905 | 0.001424 |
| ΣFₙ       | 0.005715 | 0.004273 |

Thus, the change of profitability of assets of «New city» the positive impact of:
- an increase in the coefficient of income coverage by equity by 328.83 %, caused an increase in return on assets by 0.8844 %.
and had a negative impact:
- reducing the return on equity 2.70 %, caused reduction of profitability of assets on 0.2985 %;
- decrease of asset turnover by 4.82 %, caused reduction of profitability of assets on 0.6393%.
The net effect of three factors led to the decline of profitability of assets of «New city» 0.0534 %.

5 Discussion
The advantages of the integral method should be recognized complete decomposition of factors and no need to prioritize the factors (Tarasov, A. K., 2007).

The integral method also has significant disadvantages. These include a significant complexity of calculations even according to the above formulas, as well as the presence of a fundamental contradiction between the mathematical basis of the method and the nature of economic phenomena (Knyazev, P. N., 2009; Trenogin, V. A., 2007).

Conclusion
The author's model of return on assets of construction companies is essentially an indicator of investment, financial and operational activities (business activity) necessary to assess the level of overall competitiveness of construction companies. The return on total capital (assets) of the company directly determines both the total return and investment attractiveness.

In economic analysis, it is advisable to use the author's integral method No. 2 due to the smaller dispersion and the formation of a more optimal approximation.

The author's integral methods are aimed at qualitative improvement of the methodology of this type of analysis and the emergence of calculating the impact of any number of factors used in the original model for analysis.

At the same time, the author's methods of integral factor analysis have the main advantage – unlike the traditional method, they are applicable to
multiplicative models with any number of factors (Filatov, E. A., & Ryabchenkova A. V., 2014).

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