Integral analysis of the model of profitability of fixed assets in the construction industry of the Russian Federation

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Abstract. One of the main objectives of the company is to increase profits through the correct and rational use of fixed assets. Knowing about each element of fixed assets, their physical and moral wear and tear, and the factors that affect fixed assets, managers can improve the efficiency of using fixed assets and accelerate productivity growth. As a result, many companies strive to improve the efficiency of their fixed assets. This is the key to increasing output, which ultimately leads to higher revenues, and, consequently, to an increase in profitability. Therefore, the problem of maximum efficiency of fixed assets should become one of the key issues for any organization, not only construction. The article presents the author's model of profitability of fixed assets. Currently, the construction industry of the Russian Federation is experiencing a number of difficulties in its development, but at the same time it has a good chance of increasing its competitiveness and integration into the world market. The object of research of the article is the construction industry of the Russian Federation in the context of three main types of construction: construction of buildings; construction of engineering structures; specialized construction works. The article describes one of the author's methods of integral factor analysis, which allows you to assess the degree of influence of factors on changes in the performance indicator in an accessible and relatively simple way.

1. Introduction

Construction is a fund-forming (capital-intensive) industry, on which the formation of the national economy depends, that is, the formation of a complex economic, social, organizational, scientific and technical system depends.

The close connection of the construction industry with other sectors of the economy allows us to note the multiplicative effect of construction activities, that is, with an increase in the volume of work performed in construction, there is a corresponding increase in the cost of intermediate products, which leads to the growth of related industries (Pakhomov, E. V., & Ovchinnikova, M. S., 2019).

The construction industry sets the pace of economic development and is a very significant sector in the economy of many countries around the world. The relevance of the article is due to the dynamic development of construction services in the last few decades in the world economy. At the same time, this industry reacts very painfully even to minor changes in the global market environment.

2. Research questions
One of the main tasks of financial management in the company is to ensure financial stability, which could contribute to the growth of profitability.

The initial formula for factor analysis of the profitability on fixed assets (POFA) will look like this (formula 1):

\[ \text{POFA} = \frac{V}{OF} \cdot \frac{PP}{V} = \text{ROFA} \cdot \text{ROS} = F_1 \cdot F_2 \]  

where:

- \( \text{ROFA} (F_1) \) – return on fixed assets is calculated as the ratio of net revenue \( (V) \) to the average annual cost of fixed assets \( (OF) \). The average annual cost is obtained by adding the cost of the fund at the beginning and end of the year and dividing the result by 2. Return on fixed assets – an economic indicator that characterizes the level of efficiency in the use of fixed assets of a company or industry. This is a coefficient that shows how effectively the company uses all its production facilities (Bakanov, M. I., 2011; Basovskiy, L. E., 2003; Gernalovich, N. A., 2011).

- \( \text{ROS} (F_2) \) – the return on sales is calculated as the ratio of sales profit \( (PP) \) to net revenue \( (V) \). Return on sales shows the share of profit from sales in each earned monetary unit (or revenue unit). ROS is an indicator of a company's pricing policy and its ability to control costs. Differences in competitive strategies and product lines cause a significant variety of values of return on sales in different companies. It is often used to evaluate the operational performance of companies (Gilyarovskaya, L. T., 2011; Kochergin, A. L., & Chernysheva, Yu. G., 2007; Kovalev, V. V., & Volkova, O. N., 2002).

Resultant indicator in the author's model – profitability of fixed assets (POFA), it is calculated as the ratio of profit from sales \( (PP) \) to the average annual cost of fixed assets \( (OF) \). Profitability of fixed assets (POFA) – the most important indicator of the company's performance. It is used to evaluate the company's capabilities and the profit generated by the production funds involved in creating the company's products, as well as all the fixed assets available in the company. Fixed assets are assets that an organization uses to produce goods or services and that are not consumed, but only worn out. For example, buildings, equipment, electrical networks, cars, and so on. POFA shows the return on the use of fixed assets that are involved in the production of a product or service (Lysenko, D. V., 2008; Plaskova, N. S., 2009; Pyastolov, S. M., 2010).

The purpose of the research is to analyze the author's model of profitability of fixed assets in the construction industry using the author's integral method of factor deterministic analysis.

### 3. Materials and methods

The initial data for the analysis of the author's model of profitability of fixed assets in the construction industry of the Russian Federation using the Filatov integral method (Filatov, E. A., 2019) are presented in table 1.

The object of research is the construction industry of the Russian Federation in the context of three main types of construction: construction of buildings; construction of engineering structures; specialized construction works.

The sources of the information base for analysis are the directory of financial indicators of the Russian Federation's industries, published on the website [https://www.testfirm.ru/](https://www.testfirm.ru/), which was created by auditors based on data from 2.1 million companies.

Types of construction in table 1 are presented by the scale of companies by revenue for the year:

- nanoenterprises – up to 10 million rubles;
- microenterprises – from 10 to 120 million rubles;
- small enterprise – from 120 to 800 million rubles;
- medium-sized enterprises – from 800 to 2000 million rubles;
- large enterprises – over 2000 million rubles.

**Table 1.** Initial data for integral factor analysis for the construction industry of the Russian Federation.
| No. | Indicators                                      | № factor's | 2018 year Plan (0) * | 2019 year Fact (I) ** | Deviation (Δ) *** |
|-----|-----------------------------------------------|------------|---------------------|----------------------|------------------|
|     | ROFA (Return On Fixed Assets)                 | F₁         |                     |                      |                  |
| 1   | All enterprises of the Russian Federation      |            | 16.090              | 16.390               | 0.300            |
| 2   | Construction of buildings                     |            | 24.340              | 22.960               | -1.380           |
|     | including:                                    |            |                     |                      |                  |
|     | - nanoenterprises                             |            | 5.890               | 5.280                | -0.610           |
|     | - microenterprises                            |            | 31.230              | 28.690               | -2.540           |
|     | - small enterprise                            |            | 52.300              | 49.440               | -2.860           |
|     |   - medium-sized enterprises                   |            | 67.480              | 60.360               | -7.120           |
|     | - large enterprises                           |            | 63.650              | 71.780               | 8.130            |
| 3   | Construction of engineering structures         |            | 13.790              | 14.300               | 0.510            |
|     | including:                                    |            |                     |                      |                  |
|     | - nanoenterprises                             |            | 6.280               | 5.800                | -0.480           |
|     | - microenterprises                            |            | 15.440              | 16.360               | 0.920            |
|     | - small enterprise                            |            | 17.170              | 16.650               | -0.520           |
|     |   - medium-sized enterprises                   |            | 24.220              | 21.420               | -2.800           |
|     | - large enterprises                           |            | 18.860              | 20.990               | 2.130            |
| 4   | Specialized construction works                 |            | 27.270              | 26.140               | -1.130           |
|     | including:                                    |            |                     |                      |                  |
|     | - nanoenterprises                             |            | 13.000              | 12.020               | -0.980           |
|     | - microenterprises                            |            | 34.900              | 32.670               | -2.230           |
|     | - small enterprise                            |            | 50.270              | 43.590               | -6.680           |
|     |   - medium-sized enterprises                   |            | 54.600              | 60.000               | 5.400            |
|     | - large enterprises                           |            | 35.440              | 41.900               | 6.460            |
|     | ROS (Return On Sales)                         | F₂         |                     |                      |                  |
| 1   | All enterprises of the Russian Federation      |            | 0.023               | 0.022                | -0.001           |
| 2   | Construction of buildings                     |            | 0.015               | 0.016                | 0.001            |
|     | including:                                    |            |                     |                      |                  |
|     | - nanoenterprises                             |            | 0.022               | 0.020                | -0.002           |
|     | - microenterprises                            |            | 0.013               | 0.015                | 0.002            |
|     | Article I. - small enterprise                 |            | 0.009               | 0.010                | 0.001            |
|     | Article II. - medium-sized enterprises         |            | 0.010               | 0.011                | 0.001            |
|     | Article III. - large enterprises              |            | 0.012               | 0.012                | 0.000            |
| 3   | Article IV. Construction of engineering structures |        | 0.019               | 0.019                | 0.000            |
|     | Article V. - included                         |            |                     |                      |                  |
| Article VI. | nanoenterprises | microenterprises | small enterprise | medium-sized enterprises | large enterprises | Specialized construction works | POFA (Profitability Of Fixed Assets) |
|------------|-----------------|------------------|------------------|-------------------------|------------------|-----------------------------|----------------------------------|
| 4          | 0.026           | 0.018            | 0.013            | 0.012                   | 0.012            | 0.021                       | 0.370                            |
|            |                 |                  |                  |                         |                  | 0.365                       | -0.009                           |
|            |                 |                  |                  |                         |                  | 0.367                       | 0.002                            |
|            |                 |                  |                  |                         |                  | 0.262                       | 0.272                            |
|            |                 |                  |                  |                         |                  | 0.573                       | 0.523                            |

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 balance of deviations according to the author's model of profitability of fixed assets is as follows (formula 2):

$$\Delta POFA = \sum_{n=1}^{2} POFA (F_n) = \Delta POFA (F_1) + \Delta POFA (F_2)$$ (2)

The algebraic sum of the influence of factors must be equal to the total increase in the effective indicator. The absence of such equality indicates errors in the calculations.

Below we present the author's integral method # 1 of factor analysis.

The calculation of the influence of factors on the change in the performance indicator ($\Delta POFA$) is presented using method # 1 for 2 factors is presented in formulas 3-4:

$$\Delta POFA (F_1) = \left(\frac{\Delta F_1}{n}\right) * (FON\#1) + Z\#1$$ (3)

$$\Delta POFA (F_2) = \left(\frac{\Delta F_2}{n}\right) * (FON\#2) + Z\#1$$ (4)

where: an additional increase in the effective indicator due to the interaction of factors equally between them ($Z$) is presented in the formula 5.

When using the author's integral method, the additional increase in the effective indicator («indecomposable remainder» – $Z$), formed as a result of the interaction of factors, is distributed equally between them.

$$Z\#1 = \Delta POFA - \sum\left(\left(\frac{\Delta F_n}{n}\right) * (FON\#1)\right)/n$$ (5)

where:
- $Z$ – additional increase in the effective indicator due to the interaction of factors equally between them;
- $FON\#1$ – the main part of the formula of the author's integral method No. 1;
- $\Delta F_n$ – deviation by a certain factor;
- $n$ – number of factors involved in the analysis.

where: $FON\#1$ – the main part of the formula of the author's integral method No. 1 is calculated using formulas 6–7:

$$FON\#1_1 = 2 * \left(F_2(0) + F_2(I)\right)$$ (6)

$$FON\#1_2 = 2 * \left(F_1(0) + F_1(I)\right)$$ (7)

4. Results

The calculation of the components of formulas using the author's integral method No. 1 is presented in table 2.

Table 2. Components of the formula according to the author's integral method No. 1.

| № formulae | $\Delta F_n / n$ | parts of the formula | main part of the formula (FON\#1) | $Z$ |
|------------|------------------|----------------------|----------------------------------|-----|
| 1          | $\Delta POFA (F_1) = (\Delta F_1 / 2)$* | 2 * ( $F_2(0) + F_2(I)$) | $Z$ |
| 2          | $\Delta POFA (F_2) = (\Delta F_2 / 2)$* | 2 * ( $F_1(0) + F_1(I)$) | $Z$ |

The results of the author's integral method No. 1 for analyzing the model of profitability of fixed assets in the construction industry of the Russian Federation are presented in tables 4, 5, 6.
Table 3. Result for the author's integral method No. 1 in general for all Russian companies.

| № factor's | parts of the formula |  |  |  |
|------------|----------------------|---|---|---|
|            | ∆F / n               | main part of the formula (FON№1) | Z№1 | Final result |
| 1          | ∆POFA (F1) = 0.150   | 0.090                         | 0.005 | 0.018      |
| 2          | ∆POFA (F2) = -0.001  | 64.960                        | 0.005 | -0.027     |
| Total      |                      | -0.019                        | 0.009 | 0.009      |

Table 4. Result for the author's integral method No. 1 in general for all Russian companies engaged in building construction.

| № factor's | parts of the formula |  |  |  |
|------------|----------------------|---|---|---|
|            | ∆F / n               | main part of the formula (FON№1) | Z№1 | Final result |
| 1          | ∆POFA (F1) = -0.690  | 0.062                         | -0.001 | -0.044     |
| 2          | ∆POFA (F2) = 0.001   | 94.600                        | -0.001 | 0.046      |
| Total      |                      | 0.005                         | -0.002 | 0.002      |

Table 5. Result of the author's integral method No. 1 in general for all Russian companies engaged in the construction of engineering structures.

| № factor's | parts of the formula |  |  |  |
|------------|----------------------|---|---|---|
|            | ∆F / n               | main part of the formula (FON№1) | Z№1 | Final result |
| 1          | ∆POFA (F1) = 0.255   | 0.076                         | -0.005 | 0.015      |
| 2          | ∆POFA (F2) = 0.000   | 56.180                        | -0.005 | -0.005     |
| Total      |                      | 0.019                         | -0.010 | 0.010      |

Table 6. Result of the author's integral method No. 1 in general for all Russian companies engaged in specialized construction works.

| № factor's | parts of the formula |  |  |  |
|------------|----------------------|---|---|---|
|            | ∆F / n               | main part of the formula (FON№1) | Z№1 | Final result |
| 1          | ∆POFA (F1) = -0.565  | 0.082                         | 0.025 | -0.021     |
| 2          | ∆POFA (F2) = -0.001  | 106.820                       | 0.025 | -0.029     |
| Total      |                      | -0.100                        | 0.050 | -0.050     |

As can be seen from the final result of tables 1, 3, 4, 5, 6, the goal of the analysis is achieved – the determination of the influence of factors is disclosed without deviations.

Conclusion based on the results of analysis 1
The final change in the profitability on fixed assets of all Russian companies was positively affected by a 30% increase in return on fixed assets, which caused an increase in the profitability on fixed assets by 1.8%.

The final change in the profitability on fixed assets of all Russian companies was negatively affected by a decrease in the return on sales by -0.1%, which caused a decrease in the profitability on fixed assets by -2.7%.

The combined effect of two factors led to a decrease in the profitability of fixed assets of all Russian companies by -0.9%.

**Conclusion based on the results of analysis 2**

The final change in the profitability on fixed assets of all Russian companies engaged in the construction of buildings was positively affected by an increase in the return on sales by 0.1%, which caused an increase in the profitability on fixed assets by 4.6%.

The final change in the profitability on fixed assets of all Russian companies engaged in building construction was negatively affected by a -138% decrease in return on fixed assets, which caused a -4.4% decrease in the profitability on fixed assets.

The combined effect of two factors led to an increase in the profitability of fixed assets of all Russian companies engaged in building construction by 0.2%.

**Conclusion based on the results of analysis 3**

The final change in the profitability of fixed assets of all Russian companies engaged in the construction of engineering structures was influenced by an increase in return on fixed assets by 51%, which caused an increase in the profitability of fixed assets by 1%.

**Conclusion based on the results of analysis 4**

The final change in the profitability of fixed assets of all Russian companies engaged in specialized construction work was negatively affected by:

- decrease in return on fixed assets by -113%, caused a decrease in the profitability on fixed assets by -2.1%;
- a decrease in the return on sales by -0.1%, caused a decrease in the profitability on fixed assets by -2.9%.

The combined effect of two factors led to a 5% decrease in the profitability of fixed assets of all Russian companies engaged in specialized construction work.

Using the data in tables 1 and 2, it is possible to calculate the impact on the change in the profitability of fixed assets in the construction industry of the Russian Federation by the scale of companies engaged in various types of construction.

5. Discussion

Table 1 shows that the average return on fixed assets in the Russian economy is 1600%, i.e. 1 ruble of the value of fixed assets creates about 16 rubles of income. At the same time, in the construction industry, return on fixed assets is higher on average in the Russian economy, with the exception of construction of engineering structures. For example, when building buildings, the average return on fixed assets is 2300%, and for special construction works, the return on fixed assets is about 2000%. In the construction of engineering structures, the return on fixed assets is about 1400%.

According to the second factor, the return on sales in the Russian economy is 2.2%, that is, 1 ruble of revenue accounts for about 2.2 kopecks of profit from sales. At the same time, in the construction industry, the return on sales is lower for all three types of construction. Thus, in the construction of buildings, the return on sales is 1.6%, in the construction of engineering structures – 1.9%, and in special construction works – 2%. In 2019, the return on sales in the construction industry of the Russian Federation increased slightly – by 0.1%.

The resultant indicator – the profitability on fixed assets on average for the Russian economy in 2019 compared to 2018 decreased by almost 1%. Thus, in the construction of buildings, the profitability of fixed assets remained almost unchanged in the construction of engineering structures is an increase of 1%, while special construction works reduced by 5%.
6. Conclusion
The construction industry plays a significant role in the socio-economic development of any country, being an important factor in its stability, and it also serves as the material basis for the continuous development of the national economy, solving the housing problem, and improving the material level of the people (Karyakina, I. E., & Potapkina, E. K., 2019).

Factor analysis is aimed at identifying the influence of individual factors on the performance indicator, so deterministic modeling of factor systems is a simple and effective means of formalizing the relationship of economic indicators, which serves as the basis for quantifying the role of individual factors in the dynamics of changes in the overall indicator (Bartholomew, D. J., 1984). Due to the fact that factor deterministic factor analysis is aimed at identifying the influence of factors on the value of the effective indicator of interest excluding errors, it is most relevant for practical application in market relations (Filatov, E. A., 2018).

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