Author's factor analysis of the profitability of fixed assets in the construction industry of the Russian Federation

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Abstract. The construction complex of the Russian Federation is one of the largest and most significant sectors of the economy, which largely determines the socio-economic development of the country. The profitability of the construction industry is slightly higher than the average for the entire Russian economy as a whole. At the same time, the financial and economic indicators of the overall business in 2020 in the Russian Federation are significantly lower than their pre-crisis level. In order for any company to function properly, it needs to have certain funds and sources. And the main of these sources are fixed assets. The development of construction, like any other industry, depends on the quality condition and dynamics of fixed assets renewal. The state of fixed assets, in turn, directly depends on the amount of investment directed to their renewal. The article presents the author's model of profitability of fixed assets. The article describes 10 methods of factor analysis developed by Filatov E. A., which make it possible to draw an accessible and relatively simple conclusion about changes in the resultant indicator. 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.

1. Introduction

Construction as a branch of the economy participates in the creation of fixed assets for all sectors of the national economy. This is one of the leading industries where the vital tasks of structural adjustment of the material base of the entire production potential of the country and the development of the non-production sphere are solved. Both the rate of recovery from the crisis and the competitiveness of the domestic economy largely depend on the efficiency of the construction complex. Therefore, if the economic situation in the country worsens, then first of all its construction industry suffers.

2. Research questions

Fixed assets are usually one of the basic types of assets of an organization. And given the duration of their use and, as a rule, the high cost, the issues of analyzing the effectiveness of the use of fixed assets are of particular importance (Anaeva, Z. K., & Buzurkaeva, J. A., 2016; Bartyhanova, Sh. M., & Chernova, S. A., 2016; Blazhevich, O. G., Vasil'eva, D. O., & Shal'neva, V. V., 2017; Voroncova, N. N., 2016; Gladkova, E. P., 2014; Kobeleva, S. V., Konova, O. Yu., & Smolyaninova, P. A., 2015). The main indicator that characterizes such efficiency is the coefficient of profitability on fixed assets (POFA – Profitability Of Fixed Assets).

The initial formula for factor analysis of the profitability on fixed assets (POFA) will look like this (formula 1):
\[ POFA = \frac{V}{OF} \times \frac{PP}{V} = ROFA \times ROS = F_1 \times F_2 \]  

(1)

where:
- **ROFA** \((F_1)\) – return on fixed assets is calculated as the ratio of net revenue \((V)\) to the average annual cost of fixed assets \((OF)\).
- **ROS** \((F_2)\) – the return on sales is calculated as the ratio of sales profit \((PP)\) to net revenue \((V)\).

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 \((OF)\).

The purpose of the research is to analyze the author's model of profitability of fixed assets in the construction industry using alternative author's methods 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 alternative methods of Filatov (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.

**Table 1.** Initial data for alternative author's methods of factor analysis for the construction industry of the Russian Federation.

| No. | Indicators | № factor's | 2018 year Plan \((0)\) * | 2019 year Fact \((I)\) ** | Deviation \((\Delta)*** |
|-----|------------|------------|--------------------------|--------------------------|--------------------------|
| 1   | ROFA (Return On Fixed Assets) | F_1        | 16.090                   | 16.390                   | 0.300                    |
| 2   | All enterprises of the Russian Federation |                | 24.340                   | 22.960                   | -1.380                   |
| 3   | Construction of buildings |           | 13.790                   | 14.300                   | 0.510                    |
| 4   | Construction of engineering structures |              | 27.270                   | 26.140                   | -1.130                   |
| 1   | ROS (Return On Sales) | F_2        | 0.023                    | 0.022                    | -0.001                   |
| 2   | All enterprises of the Russian Federation |            | 0.015                    | 0.016                    | 0.001                    |
| 3   | Article I. Construction of engineering structures |           | 0.019                    | 0.019                    | 0.000                    |
| 4   | Specialized construction works |             | 0.021                    | 0.020                    | -0.001                   |
| 1   | POFA (Profitability Of Fixed Assets) |          | 0.370                    | 0.361                    | -0.009                   |
The product of the main part of the formula and the corresponding correction coefficients. The absence of such equality indicates errors in the calculations.

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

(2)

The balance of deviations according to the author's model of profitability of fixed assets is as follows

\[ \Delta \text{POFA} = \text{POFA} (F_1) - \text{POFA} (F_2) \]

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.

Auxiliary data on comparative coefficients for factor analysis are presented in table 2.

**Table 2.** Multiple comparative coefficients for one factor.

| Comparison of factors | The designation of comparative coefficient | The product of coefficients (value) |
|-----------------------|------------------------------------------|-----------------------------------|
| \( F_{10}/F_{10} \)  | \( A_1 \)                                  | 1.00                              |
| \( F_{20}/F_{20} \)  | \( A_2 \)                                  |                                   |
| \( F_{30}/F_{30} \)  | \( A_3 \)                                  | 1.00                              |
| \( F_{40}/F_{40} \)  | \( A_4 \)                                  |                                   |

10 author's methods of factor analysis are presented in table 3, in which the result is equal to the product of the main part of the formula and the corresponding correction coefficients.

**Table 3.** Methods of alternative factor analysis using comparative coefficients.

| № methods' | № formulae | formulas / calculations | the main part of the formula | adjustment factors |
|------------|------------|-------------------------|-----------------------------|-------------------|
| 1.1        | 1.1        | \( \Delta \text{POFA} (F_1) = \text{POFA} (F_1) - \text{POFA} \) | \( \text{A}_1 \) | – |
| 1.2        | 2.1        | \( \Delta \text{POFA} (F_2) = (\text{POFA} (F_2) - \text{POFA} (F_2)) \) | \( \text{A}_2 \) | – |
| 2.1        | 3.1        | \( \Delta \text{POFA} (F_3) = (\text{POFA} (F_3) - \text{POFA} (F_3)) \) | \( \text{A}_3 \) | – |
| 2.2        | 4.1        | \( \Delta \text{POFA} (F_4) = (\text{POFA} (F_4) - \text{POFA} (F_4)) \) | \( \text{A}_4 \) | – |
| 3.1        | 5.1        | \( \Delta \text{POFA} (F_5) = (\text{POFA} (F_5) - \text{POFA} (F_5)) \) | \( \text{A}_5 \) | – |
| 3.2        | 6.1        | \( \Delta \text{POFA} (F_6) = (\text{POFA} (F_6) - \text{POFA} (F_6)) \) | \( \text{A}_6 \) | – |
| 4.1        | 7.1        | \( \Delta \text{POFA} (F_7) = (\text{POFA} (F_7) - \text{POFA} (F_7)) \) | \( \text{A}_7 \) | – |
| 4.2        | 8.1        | \( \Delta \text{POFA} (F_8) = (\text{POFA} (F_8) - \text{POFA} (F_8)) \) | \( \text{A}_8 \) | – |
5.1 \[ \Delta \text{POFA} (F_1) = \Delta \text{POFA} - (\text{POFA}_1 - (\text{POFA}_1 \times A_2)) \]

5.2 \[ \Delta \text{POFA} (F_2) = \Delta \text{POFA} - (\text{POFA}_1 - (\text{POFA}_1 \times A_2)) \]

4. Results

The results for methods 1.1, 2.1, 3.1, 4.1, 5.1 for all russian companies in general are shown in table 4, the results for methods 1.2, 2.2, 3.2, 4.2, 5.2 for all russian companies in general are shown in table 5.

Table 4. Results for methods 1.1, 2.1, 3.1, 4.1, 5.1 for all russian companies in general.

| No. | the main part of the formula | adjustment factors | result |
|-----|-----------------------------|-------------------|-------|
| 1   | \( \Delta \text{POFA} (F_1) = 0.007 \) | –                 | 0.007 |
| 2   | \( \Delta \text{POFA} (F_2) = -0.016 \) | 1.019 \( A_1 \) | -0.016 |

Table 5. Results for methods 1.2, 2.2, 3.2, 4.2, 5.2 for all russian companies in general.

| No. | the main part of the formula | adjustment factors | result |
|-----|-----------------------------|-------------------|-------|
| 1   | \( \Delta \text{POFA} (F_1) = 0.007 \) | 1.045 \( A_4 \) | 0.007 |
| 2   | \( \Delta \text{POFA} (F_2) = -0.016 \) | –                 | -0.016 |

The results for methods 1.1, 2.1, 3.1, 4.1, 5.1 for all russian companies involved in building construction are shown in table 6, the results for methods 1.2, 2.2, 3.2, 4.2, 5.2 for all russian companies involved in building construction are shown in table 7.

Table 6. Results for methods 1.1, 2.1, 3.1, 4.1, 5.1 in general for all russian companies engaged in building construction.

| No. | the main part of the formula | adjustment factors | result |
|-----|-----------------------------|-------------------|-------|
| 1   | \( \Delta \text{POFA} (F_1) = -0.021 \) | –                 | -0.021 |
| 2   | \( \Delta \text{POFA} (F_2) = 0.024 \) | 0.943 \( A_4 \) | 0.023 |

Table 7. Results for methods 1.2, 2.2, 3.2, 4.2, 5.2 in general for all russian companies engaged in building construction.

| No. | the main part of the formula | adjustment factors | result |
|-----|-----------------------------|-------------------|-------|
| 1   | \( \Delta \text{POFA} (F_1) = -0.022 \) | 0.938 \( A_4 \) | -0.021 |
| 2   | \( \Delta \text{POFA} (F_2) = 0.023 \) | –                 | 0.023 |

The result for methods 1.1, 2.1, 3.1, 4.1, 5.1 in general for all russian companies engaged in the construction of engineering structures is presented in table 8, the result for methods 1.2, 2.2, 3.2, 4.2, 5.2 in general for all russian companies engaged in the construction of engineering structures is presented in table 9.
Table 8. Results for methods 1.1, 2.1, 3.1, 4.1, 5.1 in general for all Russian companies engaged in the construction of engineering structures.

| No. | the main part of the formula | adjustment factors | result |
|-----|-----------------------------|--------------------|--------|
| 1   | ΔPOFA (F₁) = 0.010          |                    | 0.010  |
| 2   | ΔPOFA (F₂) = 0.000          | 1.037             | A₁     | 0.000  |

Table 9. Results for methods 1.2, 2.2, 3.2, 4.2, 5.2 in general for all Russian companies engaged in the construction of engineering structures.

| No. | the main part of the formula | adjustment factors | result |
|-----|-----------------------------|--------------------|--------|
| 1   | ΔPOFA (F₁) = 0.010          | 1.000              | A₂     | 0.010  |
| 2   | ΔPOFA (F₂) = 0.000          |                    | 0.000  |

The result for methods 1.1, 2.1, 3.1, 4.1, 5.1 in general for all Russian companies engaged in specialized construction works is presented in Table 10, the result for methods 1.2, 2.2, 3.2, 4.2, 5.2 in general for all Russian companies engaged in specialized construction works is presented in Table 11.

Table 10. Results for methods 1.1, 2.1, 3.1, 4.1, 5.1 in general for all Russian companies engaged in specialized construction works.

| No. | the main part of the formula | adjustment factors | result |
|-----|-----------------------------|--------------------|--------|
| 1   | ΔPOFA (F₁) = -0.024         |                    | -0.024 |
| 2   | ΔPOFA (F₂) = -0.027         | 0.959              | A₁     | -0.026 |

Table 11. Results for methods 1.2, 2.2, 3.2, 4.2, 5.2 in general for all Russian companies engaged in specialized construction works.

| No. | the main part of the formula | adjustment factors | result |
|-----|-----------------------------|--------------------|--------|
| 1   | ΔPOFA (F₁) = -0.023         | 1.050              | A₂     | -0.024 |
| 2   | ΔPOFA (F₂) = -0.026         |                    | 0.000  |

As can be seen from the final result of Tables 1, 4-10 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 0.7%.

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 -1.6%.

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 2.3%.

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 -2.1% 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:
- a decrease in return on fixed assets by -113%, caused a decrease in the profitability on fixed assets by -2.4%;
- a decrease in the return on sales by -0.1%, caused a decrease in the profitability on fixed assets by -2.6%.

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.

5. Discussion
A comparison of the results of the author's method (integral No. 1 and alternative-traditional) factor analysis of changes in the profitability of fixed assets is presented in tables 12-15.

Table 12. Comparison of results by author's methods of factor analysis in general for all Russian companies.

| No. | \( \Delta \text{POFA} (\text{F}_n) \) | The result of the integral method No. 1 | Result for alternative methods | \( \Delta \) |
|-----|-------------------------------|----------------------------------------|--------------------------------|-----------|
| 1   | \( \Delta \text{POFA} (\text{F}_1) = \) | 0.018                                  | 0.007                          | -0.011    |
| 2   | \( \Delta \text{POFA} (\text{F}_2) = \) | -0.027                                 | -0.016                         | 0.011     |
|     |                               | -0.009                                 | -0.009                         | 0.000     |

Table 13. Comparison of the results of the author's methods of factor analysis in general for all Russian companies engaged in the construction of buildings.

| No. | \( \Delta \text{POFA} (\text{F}_n) \) | The result of the integral method No. 1 | Result for alternative methods | \( \Delta \) |
|-----|-------------------------------|----------------------------------------|--------------------------------|-----------|
| 1   | \( \Delta \text{POFA} (\text{F}_1) = \) | -0.044                                 | -0.021                         | 0.023     |
| 2   | \( \Delta \text{POFA} (\text{F}_2) = \) | 0.046                                  | 0.023                          | -0.023    |
|     |                               | 0.002                                  | 0.002                          | 0.000     |

Table 14. Comparison of the results of the author's methods of factor analysis in general for all Russian companies engaged in the construction of engineering structures.

| No. | \( \Delta \text{POFA} (\text{F}_n) \) | The result of the integral | Result for alternative | \( \Delta \) |
|-----|-------------------------------|---------------------------|------------------------|-----------|
Table 15. Comparison of results on the author's methods of factor analysis in general for all Russian companies engaged in specialized construction works.

| No. | ΔPOFA (F₁) | The result of the integral method No. 1 | Result for alternative methods | Δ   |
|-----|-------------|----------------------------------------|-------------------------------|-----|
| 1   | 0.015       | -0.021                                 | -0.024                        | -0.003 |
| 2   | -0.005      | -0.029                                 | -0.026                        | 0.003  |

The validity of the application of the integral method in Economics is only conditional, since it requires the continuity of the function describing the factor relationship, and an infinitesimal change in features, which in economic phenomena often cannot be in principle, since many indicators change discretely.

In practice, when analyzing the economic state of a company or industry, it is often necessary to assess the dispersion of possible values of a random variable around its average value, as well as to identify and measure the strength of the relationship between factor and resultant characteristics. According to the author, looking clearly at the variance in the results of tables 12-15, the use of traditional methods in comparison with the integral method is more justified.

6. Conclusion
In the context of the global financial crisis, the strategic goals and tactical objectives of the construction organization are changing (Farnham, P. G., 2005; Glen, A., 2002). The development strategy of a construction organization should be focused on smoothing cyclical fluctuations, leveling the development trajectory, which includes the stages of decline, business activity, stabilization and recovery. At present, the effective functioning of a construction organization requires prompt response to changes in the market situation (Dolan, E. G., & Lindsey, D. E., 1988; Boddy, D., 2002; Naylor, J., 2004). Therefore, the topic of the research is most relevant in today's times.

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