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MULTIMETHODOLOGY FOR ANALYSING FINANCIAL STATEMENTS OF ENTERPRISES ON THE EXAMPLE OF RUSSIAN FUEL AND ENERGY COMPANIES' CURRENT ASSETS

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ABSTRACT

The lack of a comprehensive study of issues related to the analysis of companies financial statements and economic activity, as well as the existence of a number of issues with no sufficient coverage, such as the dynamics of operating assets of fuel and energy companies, which are commonly analyzed on the basis of absolute indicators, not considering their share in company's total assets, makes it impossible to evaluate the dynamics of company's economic situation, including in terms of the lag between structural and temporal analysis. This study aims to develop and test a multimethod ology combining the advantages of time and structural analysis in order to analyze current assets of Russian fuel and energy sector companies. The article examines the shortcomings of the existing economic analysis methods and proposes a methodology for analyzing the companies' financial statements (index analysis). The analytical tools and methods for visualizing the results are described. The approach has been tested at random values in order to increase representativeness. An analysis of Russian fuel and energy companies' current assets served as a basis for testing the developed theoretical and methodological provisions. The causes of the dynamism of current assets components in the period from 2013 to 2017 have been identified. The advantages and disadvantages of the developed approach are listed. Based on the results of testing, this approach can be considered as applicable to Russian companies reporting.

Disciplinary: Multidisciplinary (Financial Engineering, Mathematics, Economic Sciences).

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1. INTRODUCTION

The main methods of financial analysis, such as horizontal analysis; vertical analysis; trend analysis; comparative (spatial) analysis; factor analysis; method of financial ratios, - has developed through practice (Melnichuk & Ogorelkova, 2014).

The horizontal and vertical methods are the most common. Vertical or structural analysis is used by such economic scientists as Parshina Y. O., Vasilenko A. A., Molotkov Yu. I., Pokidysheva L. I. and Pokidysheva E. V. Horizontal or time analysis is used or described in the works of the following scientists: Milyutina Yu. V., Levina E.I., Egorova S.E., Maidetskaya O. Yu., Skrynskaya O.A., Simonenko L.G.

The principal shortcoming of these two methods is the decomposition of the whole company's status into two categories: the structure and the actual volume of an asset/liability, etc. To obtain a more complete and holistic analysis and more representative data, it is suggested to use the average trend index.

2. RESULTS

2.1 MULTIMETHODOLOGY TESTING

An analysis of five random components in four time periods was carried out Companies' test the developed multi-methodology (Table 1).

Table 1: Random values of components 1-5 and calculation of indicators.

t		0	1	$I_{a,1}$	2	$I_{a,2}$	3	$I_{a,3}$
a	1	2	3	1.42	4	1.23	2	0.48
	2	6	8	1.26	9	1.04	10	1.06
	3	8	7	0.83	10	1.32	12	1.15
	4	5	4	0.76	3	0.69	4	1.28
	5	4	6	1.42	7	1.07	8	1.09
A		25	28	-	33	-	36	-

2.1.1 INDICATORS BY COMPONENTS (IC)

The first stage of the analysis is a calculation of indicators by components (IC). The components reflect the average growth rate of each component based on its absolute value and share (Table 1). The following formula was used in calculations

$$I_{a,t} = \sqrt{T_{a_t} T_{x_t}} = \sqrt{\frac{a_t}{a_{t-1}} \frac{a_t}{a_{t-1}} \frac{A_{t-1}}{A_t}} = \frac{a_t}{a_{t-1}} \sqrt{\frac{A_{t-1}}{A_t}} = \frac{T_{a_t}}{\sqrt{T_{A_t}}} \quad (1)$$

where a is the absolute value of ($a = \{1,2,\dots,k\};\ a \in A, where\ k\ denotes\ integer\ numbers$), A is the sum of absolute values of all a, x is the share of a in A, t is time period ($t = \{1,2,\dots,p\}$), T is the growth rate of value, $I_{a,t}$ is the indicator of a in the period t.

The surface plot $I_{a,t} = f(T_{a_t}, T_{x_t}) = \sqrt{T_{a_t} T_{x_t}}$ can be conditionally divided into six main areas, which all may be considered as a base for assessment of dynamics. The surface plot $I_{a,t} = q(T_{a_t}, T_{A_t}) = \frac{T_{a_t}}{\sqrt{T_{A_t}}}$ (Figure 1) can be considered in a similar way.

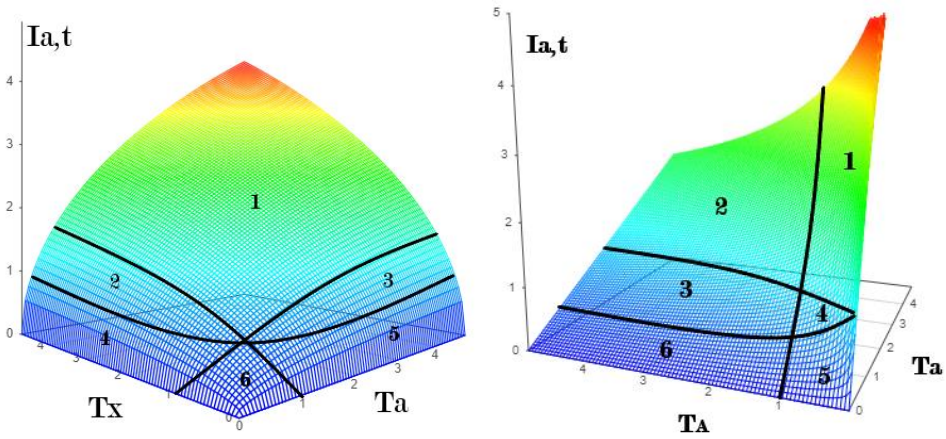


Figure 1: Surface plots of indicators by components.

2.1.2 IC LIMIT AND 2D IC SURFACE PLOT

It is worth noting that the limit of IC change at the components sum growth rate tending to zero is equal to infinity (2), i.e. a certain component has an unconditional growth trend only under the condition that the components sum growth rate tends to zero at the component absolute value growth rates other than zero.

$$\lim_{T_{A_t}\to 0} I_{a,t} = \infty, if\ T_{a_t} \neq 0 \qquad (2)$$

To simplify the visualization, it is possible to consider projections of two surfaces on a plane excluding the axis of the index (Figure 2). The screening method was used to construct the projections. For screening in the picture plane, a rectangle with sides parallel to the coordinate axes, inside which the image will be enclosed, is drawn (Bayakovskii et al., 1985).

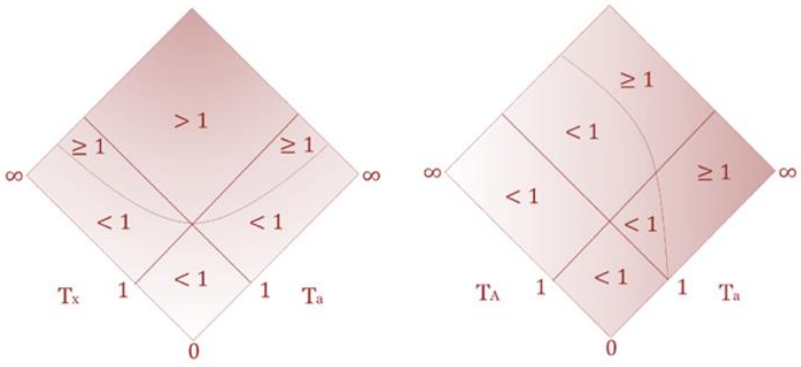


Figure 2. IC surface plot projections

2.1.3 TREND INDICES BY COMPONENT (TIC)

Calculating the IC for *n* companies, the sample averages of a and A are used, as well as smoothing for a change in the *n* number of companies:

$$I_{\bar{a},t} = \sqrt{\left(\frac{\frac{\sum_{i=1}^{n_t} a_{i,t}}{n_t}}{\frac{\sum_{i=1}^{n_{t-1}} a_{i,t-1}}{n_{t-1}}}\right)\left(\frac{\frac{\sum_{i=1}^{n_t} a_{i,t}}{\sum_{i=1}^{n_t} A_{i,t}}}{\frac{\sum_{i=1}^{n_{t-1}} a_{i,t-1}}{\sum_{i=1}^{n_{t-1}} A_{i,t-1}}}\right)} = \sqrt{\frac{n_t{}^{-1}\frac{\left(\sum_{i=1}^{n_t} a_{i,t}\right)^2}{\sum_{i=1}^{n_t} A_{i,t}}}{n_{t-1}{}^{-1}\frac{\left(\sum_{i=1}^{n_{t-1}} a_{i,t-1}\right)^2}{\sum_{i=1}^{n_{t-1}} A_{i,t-1}}}} = \frac{\bar{a_t}}{\bar{a}_{t-1}}\left(\frac{\bar{A}_{t-1}}{\bar{A}_t}\right)^{\frac{1}{2}} \qquad (3),$$

where $I_{a,t}^{n}$ is the average index by component (AIC) of value a in the period t for n companies;

n_t is the number of companies in the period t.

The second stage is the calculation of trend indices by component (TIC) as each index deviations (Table 2).

Table 2: Trend indices by component (TIC) calculation

t		1			2			3		
Index		$I_{a,t}$	$\bar{I}_{a,1}$	$\Delta_{a,1}$	$I_{a,t}$	$\bar{I}_{a,2}$	$\Delta_{a,2}$	$I_{a,t}$	$\bar{I}_{a,3}$	$\Delta_{a,3}$
a	1	1.42	1.14	28%	1.23	1.07	16%	0.48	1.01	-53%
	2	1.26		12%	1.04		-3%	1.06		5%
	3	0.83		-31%	1.32		25%	1.15		14%
	4	0.76		-38%	0.69		-38%	1.28		26%
	5	1.42		28%	1.07		1%	1.09		8%

Most of the economic indicators time-series have a tendency that characterizes the cumulative long-term effect of many factors on the dynamics of the indicator being studied. Each factor, taken separately, can have a multidirectional effect on the studied indicator, and in the aggregate, it can form the increasing or decreasing tendency. The trend component is a smoothly changing trend of growth or decline, which effect accumulates gradually over several years (Skvortsov, 2008). The trend component of IC is calculated as

$$\bar{I}_{a,t} = \frac{1}{k}\sum_{a=1}^{k} I_{a,t} \quad (4),$$

where $\bar{I}_{a,t}$ is an average index by component (AIC) of value a in the period t.

From this, a trend index by component (TIC) is formed (4). This operation allows us to take into account the error in the general trend, which may be caused by unaccounted externalities and shows the actual deviation from the general trend.

$$\Delta_{a,t} = I_{a,t} - \bar{I}_{a,t} = \left(\frac{a_t}{a_{t-1}}\sqrt{\frac{A_{t-1}}{A_t}}\right) - \frac{1}{k}\sum_{a=1}^{k}\left(\frac{a_t}{a_{t-1}}\sqrt{\frac{A_{t-1}}{A_t}}\right) \quad (5),$$

where $\Delta_{a,t}$ is the trend index by the component of a value in the period t. (Equation (5) The calculations are verified using the following formula :$\sum_{a=1}^{k}\Delta_{a,t} = 0$). To evaluate the obtained results, the following method of index grouping is suggested:

$\Delta < -10\%$ - decreasing trend;

$-10\% \le \Delta < -5\%$ - acceptable decrease rate;

$-5\% \le \Delta \le 5\%$ - permissible variation;

$10\% \ge \Delta > 5\%$ - acceptable growth rate;

$\Delta > 10\%$ - increasing trend.

At the third and final stage, the average trend indices by component (ATIC) are calculated in order to assess the cumulative changes for all time periods (Table 3).

Table 3: ATIC calculation

a	$G_{a,p}$	G_p	$\Delta_a^{average}$	Nature of changes
1	0.94	1,04	-10%	Acceptable decrease rate
2	1.12		8%	Acceptable growth rate
3	1.08		4%	Permissible variation
4	0.87		-17%	decreasing trend
5	1.19		15%	increasing trend

2.1.4 TREND COMPONENT

Performance in a certain period was calculated

$$G_{a,p} = \left(\prod_{t=1}^{p} I_{\bar{a},t}\right)^{\frac{1}{p}} = \left(\frac{\bar{a}_p}{\bar{a}_0}\left(\frac{\bar{A}_0}{\bar{A}_p}\right)^{\frac{1}{2}}\right)^{\frac{1}{p}} = \left(\bar{T}_{\bar{a}_t}\bar{T}_{\bar{x}_t}\right)^{\frac{1}{2p}} \quad (6),$$

where $G_{a,p}$ is AIC (IC) aggregate of a value in p periods of time. In order to identify the general trend in the dynamics of all considered components, the average aggregate was calculated as

$$\overline{G_p} = \frac{1}{k}\sum_{a=1}^{k} G_a = \frac{1}{k}\sum_{a=1}^{k}\left(\prod_{t=1}^{p} I_{a,t}\right)^{\frac{1}{p}} = \frac{1}{k}\sum_{a=1}^{k}\left[\left(\bar{T}_{\bar{a}_t}\bar{T}_{\bar{x}_t}\right)^{\frac{1}{2p}}\right] \quad (7),$$

where $\overline{G_p}$ is the trend component of a AIC (IC) value in p periods for k number of components. ATIC is calculated as

$$\Delta_a^{average} = G_{a,p} - \overline{G_p} \quad (8),$$

where $\Delta_a^{average}$ is ATIC of a value in p periods for k number of components in n companies. This allows us to take into account the influence of both external and internal factors, to separate the component dynamics deviation from the general trend. The expanded formula is as follows

$$\Delta_a^{average} = \left(\prod_{t=1}^{p}\left(\frac{\overline{a_t}}{\bar{a}_{t-1}}\left(\frac{\bar{A}_{t-1}}{\bar{A}_t}\right)^{\frac{1}{2}}\right)\right)^{\frac{1}{p}} - \frac{1}{k}\sum_{a=1}^{k}\left[\left(\prod_{t=1}^{p}\left(\frac{\overline{a_t}}{\bar{a}_{t-1}}\left(\frac{\bar{A}_{t-1}}{\bar{A}_t}\right)^{\frac{1}{2}}\right)\right)^{\frac{1}{p}}\right] \quad (9),$$

$$\Delta_a^{average} = \left(\frac{\bar{a}_p}{\bar{a}_0}\left(\frac{\bar{A}_0}{\bar{A}_p}\right)^{\frac{1}{2}}\right)^{\frac{1}{p}} - \frac{1}{k}\sum_{a=1}^{k}\left[\left(\frac{\bar{a}_p}{\bar{a}_0}\left(\frac{\bar{A}_0}{\bar{A}_p}\right)^{\frac{1}{2}}\right)^{\frac{1}{p}}\right] = \left(\bar{T}_{\bar{a}_t}\bar{T}_{\bar{x}_t}\right)^{\frac{1}{2p}} - \frac{1}{k}\sum_{a=1}^{k}\left[\left(\bar{T}_{\bar{a}_t}\bar{T}_{\bar{x}_t}\right)^{\frac{1}{2p}}\right] \quad (10).$$

Equation (10), the calculations are verified using: $\sum_{a=1}^{k}\Delta_a^{average} = 0$.

The testing of multimethodology allowed for the following conclusions: 1) The computational part of the methodology has been formulated correctly; 2) The proposed grouping of values is sufficient for analysis; 3) The hypothesis for the multimethodology capacity to level off the lag of structural and temporal analysis of financial statements has been confirmed.

2.2 IC-BASED ANALYSIS OF ENERGY AND FUEL COMPANIES CURRENT ASSETS

To determine the need for working capital, its composition, and the structure of its sources, it is necessary to determine their economic substance. Knowing the specifics of formation and use of these assets, it is possible to ensure the rhythm, coherence and high productivity of operation, which can help to increase profitability, to strengthen and improve the material and technical base and to create conditions for expanded reproduction, without which it is difficult to imagine the existence of an enterprise in market conditions (Zavgorodnaya & Prudnikov, 2017).

Given the limited financing of oil, gas and coal industries, the implementation of intensive enterprise development is particularly relevant. The main tasks of current assets management are the following:

- monitoring and providing the appropriate values of working capital components
- ensuring the efficient use of current assets

- effective planning, regulation, and reduction of assets turnover

To obtain these goals, the management process must be organized in accordance with the information needs of a comprehensive and systematic analysis of the effective use of working capital components, identifying the causes of deviations of actual assets from the planned ones, as well as defining the possible consequences of such deviations and optimizing the structure of current assets in the future (Orlova, 2010).

For the analysis of current assets, the SPARK information resource of the Interfax News Agency was used. The Russian fuel and energy companies with the following business activity code numbers by OKVED (All-Rusian Classifier of Economic Activities): 05.10.1, 05.10.2, 06.1, 06.2 (Russian Classification of Economic Activities 029-2014). As a result, the number of enterprises was 828 (2013), 957 (2014), 1069 (2015), 1145 (2016), 1192 (2017). To form the analytical base, a correlation-regression analysis of the collected data was carried out.

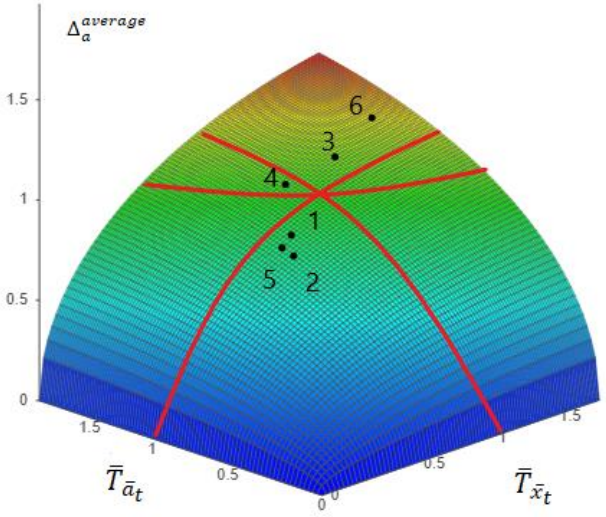
The study of economic literature and practical materials showed that, taking into account the specifics of oil and gas production (field conditions of work, the specifics of each object of geological research, drilling, production, pumping and transportation, the impact of hardly predicted external factors), the problems of organizing current assets analysis and management require undertaking more research (Grynyuk & Orlova, 2018).

IC was used to analyze energy and fuel companies' current assets, and the following ATIC data were obtained (Table 4).

Table 4: ATIC of Russian energy and fuel (oil, gas, coal) companies' current assets in the period from 2013 to 2017.

$\Delta_a^{average}$	Oil	Gas	Coal	Industry
Reserves	-6%	-20%	-1%	-4%
Input VAT	-7%	-37%	-2%	-11%
Account receivable	8%	-9%	13%	9%
Short-term financial investments	1%	81%	11%	3%
Cash and cash equivalents	-11%	-17%	-19%	-10%
Other current assets	15%	2%	-2%	13%

Source: calculation based on SPARK data.



1 – Reserves; 2 – Input VAT; 3 – Account receivable; 4 – Short-term financial investments; 5 – Cash and cash equivalents; 6 – Other current assets (Order of Ministry of Finance N 43n of July 06, 1999)

Figure 3: ATIC values of energy and fuel companies

2.1.5 APPLICATIONS

Sectoral indicators of the average trend index have the greatest degree of correlation (0.973) with the performance of oil companies, which is caused by the share of these companies in the overall structure.

A cross-industry trend consists of a decrease in cash and cash equivalents, reduction in input VAT and a smaller reduction in reserves in the period 2013-2017 by 10%, 11%, and 4%, respectively.

However, only the trend of "cash and cash equivalents" can be considered as general, as it is similar in each sub-sector under consideration: oil (-11%), gas (-17%), coal (-19%). The main reasons for such changes are the following: on the one hand, the increase in long-term financial investments of energy companies since 2011-2012 and their transition to short-term financial investments in 2015-2016; and on the other hand, structural changes in the markets: active use of technologies for liquefying natural gas, condensate gas production, increase in the fleet of oil and LNG tankers, increased oil polymers market and modernization of refineries.

The sharp increase in short-term financial investments in the gas sector was caused by the development of technologies for liquefying natural gas in Russia and an increase in the localization level of both LNG tankers and auxiliary technological equipment production. The indicator was mainly influenced by the activities of PJSC NOVATEK and PJSC Gazprom Neft joint venture - JSC Arktikgaz, with short-term financial investments of 128 billion rubles in 2017 (having increased by more than 84 times since 2016). The Company is currently implementing an investment project to develop the Samburg and Evo-Yakhinsky license areas. The growth of short-term investments was caused by the shortened maturity of a long-term 104 billion rubles loan issued in 2015 for a period of 3 years. Presumably, this loan may be associated with a change in the ownership structure in 2014-2015, namely, the transfer of SeverEnergia and their subsidiaries shares to NOVATEK and Gazprom Neft (the rationale was a corresponding increase in long-term obligations of PJSC Gazprom Neft). These changes were the first stage of the transition to the equal ownership of Arktikgaz. In the first quarter of 2018, NOVATEK and PJSC Gazprom Neft completed the final stage of the restructuring that had already begun. In January 2018, Arcticgas adhered to Yamal Development and SeverEnergia. As a result, NOVATEK and Gazprom Neft received 53.3% and 46.7% shares in the company, respectively. Subsequently, in March 2018, Gazprom Neft bought out an additional issue of Arktikgaz shares for a total amount of 32.098 million rubles, increasing its share to 50% (SPARK information resource of the "Information Agency Interfax", 2019)

The accounts receivable are the driver of sales revenue growth in the energy and fuel sector; hence, they have changed along with the change in industrial practices. In other words, implementing prepayment on fuel and energy supply contracts, and reducing sales on credit and payment delays, would result in a much smaller sales volume. It is important to note that for most long-term contracts in the fuel and energy sector, payment usually follows delivery.

The repayment rate is proportional to the optimization of the company accounting process. Sutyagin & Bespalov (2014) claims that "...accounting of receivables is one of the most difficult areas of enterprise accounting due to the high repeatability (periodicity) of these operations, a wide variety of payment forms, a large number of counterparties, etc".

3. DISCUSSION

3.1 PRECONDITIONS FOR MULTIMETHODOLOGY

With a normal increase in the absolute components corresponding to the increase in total amount, the data obtained by means of standard methods of economic analysis have a high level of correlation, and, as a result, a high level of representativeness. However, in this case, the structural and temporal approaches have a similar nature and actually duplicate each other. At the same time, it is not possible to assess component changes in exceptional cases that stand out from the norm.

These arguments are prerequisites of a certain approach that can allow forming a complete picture of changes in components values. The proposed multimethodology completely eliminates the lag of structural and temporal analysis, providing highly representative data for an overall assessment of financial and operational company positions.

3.2 ADVANTAGES AND SHORTCOMINGS OF MULTIMETHODOLOGY

The multimethdology allows assessing changes in the components values relative to the general trend, which helps to reduce the overall error in recession/growth.

It also makes it possible for graphical visualization of obtained results in two spaces or their projections, which further increases the data representativeness and allows forming strategies for future periods.

The disadvantage of multimethodology is the inability to analyze each indicator separately, i.e. it is aimed at analyzing a number of components and their total value. Consequently, it only meets the requirements of financial statement individual parts or the entire reporting forms analysis. At the same time, it is possible to use AIC and IC to obtain the value of component change, the degree of representativeness of which is higher than the results of structural and temporal analyzes, but lower than that of the ATIC.

3.3 FORECAST VALUES

Further, the question rises if this index is reliable enough to calculate the forecast value. A forecasting technique, which consists in calculating the product of absolute a value and the index, taking into account the growth rate of the previous period, is suggested

$$\hat{a}_{t+1} = a_t I_{a,t} = a_t \frac{T_{a_t}}{\sqrt{T_{A_t}}} = a_t \frac{a_t}{a_{t-1}} \sqrt{\frac{A_{t-1}}{A_t}} \quad (10).$$

In order to evaluate the reliability of the forecast, a comparison is made of the forecasting method proposed by the authors with a technique using exponential smoothing. The comparison is based on the analysis of average relative errors when calculating both methods.

$$\bar{\varepsilon}_{a,t} = \left(p_t^{-1} \sum_{t=1}^{p} \varepsilon_{a,t}\right) * 100 = \left(p_t^{-1} \sum_{t=1}^{p} \frac{|a_t - \hat{a}_t|}{a_t}\right) * 100 \quad (11).$$

The average relative error of the authors' technique is about 30% when the exponential smoothing gives an error of 20%. Therefore, the proposed technique is not optimal in forecasting.

4. CONCLUSION

The considered multimethodology really performs the function of composing growth factors

obtained by structural and temporal analysis, which was confirmed by the analysis of current assets in the fuel and energy sector. The multimethodology allows, as already noted, to obtain high representativeness, including through its ability to visualize the obtained values both in 2D graphs of index functions and in 3D graphs of surfaces and their projections on a non-index plane.

To test the methodology on real values, a large body of data on current assets of fuel and energy Russian companies was used. The following trends were identified:

1. The increase in short-term financial investments in the gas industry, caused by the restructuring of gas condensate companies based in northern Russia;
2. The increase of receivables throughout the industry, which is determined by the specifics of fuel and energy resources (oil, gas, coal) trading. In other words, the trend towards an increase in receivables indicates an increase in sales revenue.
3. Reduction in stocks and input VAT as components of companies current assets, the reason is the strong influence of the first two trends;
4. The decrease in cash and cash equivalents caused by the consolidation of businesses in the energy sector, being of strategic importance to Russia, as well as the technological development of industries.

Thus, the methodology of the composition of existing economic analysis methods has been developed and tested in the study.

5. MATERIALS AND DATA AVAILABILITY

Information is available by contacting the corresponding author.

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