

# Methodological Issues of the Study of Export Efficiency Based on the Example of Russia's Oil Industry

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**Abstract** — Financial and economic factors influencing the efficiency of oil export are investigated in the article. The methodological issues of evaluating the efficiency of exports on the example of the oil industry are considered. The relationship between factors influencing the export of oil and its effectiveness has been established. A methodology for estimating the efficiency of oil exports based on deterministic factor analysis by the method of chain substitutions is proposed. An experimental verification of the proposed approach to the estimation of income from oil exports to the Russian Federation for the period from 2014 to 2017 was carried out. The main factors that have had a positive and negative impact on the performance indicator are revealed.

**Keywords** — export, oil, oil-extracting industry, foreign trade activities

## I. INTRODUCTION

Russia holds the leading positions in oil and gas production in the world [11]. According to the International Energy Agency (IEA), Russia's share in world oil production is 11.2% (according to data for 2015), in gas production - 18.3% (according to data for 2014) [8]. The bulk of the products are delivered to international markets [2].

The work of oil producing enterprises is significantly influenced by climatic factors (low temperatures, permafrost, etc.), geographic (remoteness of fields, large expenditures for logistics and social infrastructure), technical and economic factors, such as the aging of technological equipment, the need for more complex, science-intensive equipment for development on deep horizons, with a high degree of water cut. Separately, it is necessary to distinguish the organizational and economic factors associated with the specifics of labor and production in the conditions of the rotational mode, etc. [4].

In this article, the main attention will be paid to the effect of financial and economic factors affecting the efficiency of oil exports and the methodological issues of their analysis.

## II. RELEVANCE, SCIENTIFIC SIGNIFICANCE OF THE STUDY

The relevance of the study of the factors influencing the efficiency of oil exports is confirmed by the fact that the foreign economic activity of the enterprises of the oil industry of the Russian Federation has a significant impact on the positive foreign trade balance and on the currency savings in the country's budget.

The scientific significance of the study lies in the fact that with the help of deterministic factor analysis it is possible to clarify and consistently reveal the influence of each factor on the efficiency of oil exports.

## III. FORMULATION OF THE PROBLEM

The objective of this study is to develop an approach to assessing oil exports based on the use of methods of deterministic factor analysis.

## VI. THEORETICAL PART

The oil industry in the Russian Federation is affected by various factors, including technical, economic, organizational, economic and financial. This industry provides a significant part of the proceeds from exports. Hence, it is important to analyze how efficient the export of oil is, and what causes are reflected in its results.

According to the Federal State Statistics Service, it is possible to see and analyze the changes in the size and structure of the costs of oil production and sales. With the growth of the total cost of 1 ton of oil three times, the cost of production has only doubled, export costs have also doubled [10]. To a greater extent, the financial and tax factor—the mineral extraction tax (MET) [3]—influenced the growth in the cost of 1 ton of oil. Omitting the specifics of calculating the severance tax, we will only dwell on the fact that the tax rate of the mineral extraction tax, taking into account the coefficient characterizing the dynamics of world oil prices (CU) for the period from 2004 to 2017, increased by 7.2 times [10].

The change in the price of oil is largely attributed to the currency crisis of the Russian Federation, which began in late

2014. In general, the fluctuation of the exchange rate is a natural process and is the norm for most of the economically developed countries of the world. The exchange rate of one currency is constantly changing in relation to another under the influence of various factors, among which we can distinguish: the prospects for changing inflation, the size of international investment, interest rates, the economic growth of the country, the change in the price of 1 ton of oil in the foreign market [1, 2, 5].

In general, it can be noted that during the crisis in 2015, the average actual export price per 1 ton of oil fell almost twofold, and the price for USD increased almost twofold. Hence, the inflow of foreign exchange funds into transit currency accounts has almost halved. Among the factors that influenced the change in this indicator, one can single out a decrease in the average actual export price per 1 ton of oil and an increase in the US dollar rate [10].

Investigating the development of export of oil products of the Russian Federation, it can be noted that its effectiveness is determined by the following factors:

- prices of 1 ton of oil in the foreign market, in US dollars;
- the average dollar exchange rate, in rubles;
- production prices of 1 ton of oil, in rubles;
- Expenses for exports, in rubles;
- the size of the tax on extraction of minerals for 1 ton of oil, in rubles;
- volumes of oil export, in tons.

Due to the fact that a significant number of factors directly or indirectly interacting with each other influence the efficiency of oil exports, we suggest using the method of chain substitutions of deterministic factor analysis for further research.

#### V. PRACTICAL SIGNIFICANCE, PROPOSALS AND RESULTS OF IMPLEMENTATION, RESULTS OF EXPERIMENTAL INSPECTIONS

Using this approach, it is possible to quantify the impact of each factor when performing a comparative analysis of oil export revenues for different time periods.

The method of using the method of chain substitutions of deterministic factor analysis in studying the efficiency of oil exports will look like this:

1) first of all, it is necessary to present a factor model in which the relationship between the analyzed factors will be determined. In our case, this model belongs to the multiplicative-additive type and looks like this:

$$\text{Dan} = (\Pi * \$ - C) * V, \quad (1)$$

where Dan - income from oil exports, in rubles;

C - the price of 1 ton of oil in the foreign market, in US dollars;

\$ - the rate of 1 US dollar in Russian rubles;

C - cost of 1 ton of oil, including production price, export costs and MET, in rubles;

V - is the volume of oil export in the external market, in tons.

In our methodology, we have identified only four major factors that affect the income of oil exports. However, if necessary, it could be found much more of such factors.

Next, it is necessary to determine the income from oil exports in actual prices for the base and reporting period:

- income from oil exports in the reporting period (Dan1)

$$\text{Dan 1} = (\text{P1} * \$ 1 - \text{C1}) * \text{V1}, \quad (2)$$

- income from oil exports in the base period (Dan0)

$$\text{Dan0} = (\text{P0} * \$ 0 - \text{C0}) * \text{V0}, \quad (3)$$

where P0, P1 - the price of 1 ton of oil export in the base and accounting period, respectively, in US dollars;

\$ 0, \$ 1 - exchange rate of 1 US dollar in Russian rubles in the base and accounting periods, respectively;

C1, C1 - cost of 1 ton of oil, including production price, export costs and MET, in the base and accounting period in rubles;

V0, V1 - the volume of oil export in the external market in the base and accounting period in tons.

3) In the next step, we will determine the deviation of the income from oil exports ( $\Delta\text{Dan}$ ), which is the algebraic difference between the value of this indicator in the reporting and base period:

$$\Delta \text{Dan} = \text{Dan 1} - \text{Dan 0}, \quad (4)$$

4) Once the difference between the value of the oil export income in the base and the reporting period is determined, it is necessary to identify factors that have had a positive and negative impact on the change in this indicator. For this, we use the method of elimination of deterministic factor analysis. This method allows you to determine the impact of each factor on the score, using chain substitutions with alternate replacement of factors from the baseline to the actual value. At the same time, first of all the values of quantitative indicators change, and then the qualitative ones. In our case, chain substitutions will look like this:

a) the first condition - we change the basic value of the volume of oil exports to the actual:

$$\text{Dan1con.} = (\text{P0} * \$ 0 - \text{C0}) * \text{V1}, \quad (5)$$

b) the second condition - we change the basic value of the price of 1 ton of oil exports in US dollars to the actual value, while the value of the volume of oil exports remains in the actual value:

$$\text{Dan2con.} = (\text{P1} * \$ 0 - \text{C0}) * \text{V1}, \quad (6)$$

c) the third condition - we change the basic value of the exchange rate of 1 US dollar in Russian rubles to the actual, while the previous factors remain in actual values:

$$\text{Dan3con.} = (\text{P1} * \$ 1 - \text{C0}) * \text{V1}, \quad (7)$$

5) After determining the intermediate values of the factors studied, we determine the impact of each factor analyzed on the result:

a) the impact of the change in the volume of oil exports on the change in income from oil exports in the reporting period:

$$\Delta \text{Dan}_v = \text{Dan1con.} - \text{Dan0}, \quad (8)$$

b) the impact of the change in the price of 1 ton of oil in US dollars on the change in income from oil exports in the reporting period:

$$\Delta \text{DanP} = \text{Dan2con.} - \text{Dan1con.}, \quad (9)$$

c) the impact of a change in the exchange rate of US \$ 1 in Russian rubles on the change in income from oil exports in the reporting period:

$$\Delta \text{Dan\$} = \text{Dan3con.} - \text{Dan2con.}, \quad (10)$$

d) the impact of a change in the cost of 1 ton of oil on the change in income from oil exports in the reporting period:

$$\Delta \text{DanC} = \text{Dan1} - \text{Dan3con.}, \quad (11)$$

6) Next, we determine the cumulative effect of all the factors studied, on the change in the indicator:

$$\Delta \text{Dan} = \Delta \text{Dan}_v + \Delta \text{DanP} + \Delta \text{Dan\$} + \Delta \text{DanC}, \quad (12)$$

We will carry out an experimental check of the proposed approach to determining the efficiency of oil exports to the Russian Federation for the period from 2014 to 2017. Note that this period for the Russian Federation was difficult, as there were significant fluctuations in the price of 1 ton of oil in the foreign market in US dollars, the US dollar exchange rate against the Russian ruble, which had a significant impact on the economic situation of the Russian Federation. We summarize the results of the calculations in a general comparative-analytical table (Table 2).

First of all, using statistical data published in open sources, we will compile a table in which we will present the initial data for each analyzed period (Table 1).

Table 1 - The initial data needed to assess the efficiency of oil exports to the Russian Federation [9, 10]

№	Indicators	2014	2015	2016	2017
1	The average price of 1 ton of oil in the foreign market, in US dollars (according to the Federal State Statistics Service)	689	367	288	370
2	The average dollar exchange rate, rubles. (according to the Central Bank of the Russian Federation)	39	61	67	58
3	The price of production of 1 ton of oil, rub. (according to FSSS), including MET and export costs	10064	11417	12607	17416
4	Export volume, million tons per year	223	245	255	253

Consider the period 2014-2015 - This period was characterized by the beginning of the economic crisis. Let's consider, what influence was rendered by investigated factors on the income from export of oil in the given period.

1) determine the revenue from oil exports in actual prices for the base (2014) and reporting (2015) years

- income from oil exports in the reporting period (Dan2015)

$$\text{Dan2015} = (367 * 61 - 11417) * 245 = 2688 \text{ billion rubles.}$$

- income from oil exports in the base period (Dan2014)

$$\text{Dan2014} = (689 * 39 - 10064) * 223 = 3748 \text{ billion rubles.}$$

2) With the next step, we will determine the deviation of income from oil exports ( $\Delta \text{Dan}$ ):

$$\Delta \text{Dan} = \text{Dan2015} - \text{Dan2014} = 2688 - 3748 = -1060 \text{ bln. Rub.}$$

3) After the difference between the value of the oil export revenue in the base and the reporting period is determined, it is necessary to identify the factors that have had a positive and negative impact on the change in this indicator:

a) the first condition - we change the basic value of the volume of oil exports to the actual:

$$\text{Dan1con.} = (689 * 39 - 10064) * 245 = 4118 \text{ billion rubles.}$$

b) the second condition - we change the basic value of the price of 1 ton of oil exports in US dollars to the actual value, while the value of the volume of oil exports remains in the actual value:

$$\text{Dan2con.} = (367 * 39 - 10064) * 245 = 1041 \text{ billion rubles.}$$

c) the third condition - we change the basic value of the exchange rate of 1 US dollar in Russian rubles to the actual, while the previous factors remain in actual values:

$$\text{Dan3con.} = (367 * 61 - 10064) * 245 = 3019 \text{ billion rubles.}$$

5) After determining the intermediate values of the factors studied, we determine the impact of each factor analyzed on the result:

a) the impact of the change in the volume of oil exports on the change in income from oil exports in the reporting period:

$$\Delta \text{Dancon} = 4118 - 3748 = 370 \text{ billion rubles.}$$

b) the impact of the change in the price of 1 ton of oil in US dollars on the change in income from oil exports in the reporting period:

$$\Delta \text{DanP} = 1041 - 4118 = -3077 \text{ billion rubles.}$$

c) the impact of a change in the exchange rate of US \$ 1 in Russian rubles on the change in income from oil exports in the reporting period:

$$\Delta \text{Dan\$} = 3019 - 1041 = 1978 \text{ billion rubles.}$$

d) the impact of a change in the cost of 1 ton of oil on the change in income from oil exports in the reporting period:

$$\Delta \text{DanC} = 2688 - 3019 = -331 \text{ billion rubles.}$$

6) Next, we determine the cumulative effect of all the factors studied, on the change in the indicator:

$$\Delta \text{Dan} = 370 + (-3077) + 1978 + (-331) = -1060 \text{ billion rubles.}$$

Period 2015-2016 was characterized by the growth of the recession, using the approach proposed above, we will determine the impact of financial and economic factors on the income from oil exports.

1) determine the income from oil exports in actual prices for the base (2015) and reporting (2016) year

- income from oil exports in the reporting period (Dan2016)

$$\text{Dan2016} = (288 * 67 - 12607) * 255 = 1706 \text{ billion rubles.}$$

- income from oil exports in the base period (Dan2015)

$$\text{Dan2015} = (367 * 61 - 11417) * 245 = 2688 \text{ billion rubles.}$$

2) In the next step, we will determine the deviation of income from oil exports ( $\Delta \text{Dan}$ ):

$$\Delta \text{Dan} = \text{Dan2016} - \text{Dan2015} = 1706 - 2688 = -982 \text{ billion rubles.}$$

3) After the difference between the value of the oil export revenue in the base and the reporting period is determined, it is necessary to identify the factors that have had a positive and negative impact on the change in this indicator:

a) the first condition - we change the basic value of the volume of oil exports to the actual:

$$\text{Dan1con} = (367 * 61 - 11417) * 255 = 2796 \text{ billion rubles.}$$

b) the second condition - we change the basic value of the price of 1 ton of oil exports in US dollars to the actual value, while the value of the volume of oil exports remains in the actual value:

$$\text{Dan2con} = (288 * 61 - 11417) * 255 = 1569 \text{ billion rubles.}$$

c) the third condition - we change the basic value of the exchange rate of 1 US dollar in Russian rubles to the actual, while the previous factors remain in actual values:

$$\text{Dan3con} = (288 * 67 - 11417) * 255 = 2009 \text{ bln. Rub.}$$

5) After determining the intermediate values of the factors studied, we determine the impact of each factor analyzed on the result:

a) the impact of the change in the volume of oil exports on the change in income from oil exports in the reporting period:

$$\Delta \text{Dancon} = 2796 - 2688 = 108 \text{ billion rubles.}$$

b) the impact of the change in the price of 1 ton of oil in US dollars on the change in income from oil exports in the reporting period:

$$\Delta \text{DanP} = 1569 - 2797 = -1228 \text{ billion rubles.}$$

c) the impact of a change in the exchange rate of US \$ in Russian rubles on the change in income from oil exports in the reporting period:

$$\Delta \text{Dan} \$ = 2009 - 1569 = 440 \text{ billion rubles.}$$

d) the impact of a change in the cost of 1 ton of oil on the change in income from oil exports in the reporting period:

$$\Delta \text{DanC} = 1705 - 2009 = -304 \text{ billion rubles.}$$

6) Next, we determine the cumulative effect of all the factors studied, on the change in the indicator:

$$\Delta \text{Dan} = 108 + (-1228) + 440 + (-304) = -982 \text{ billion rubles.}$$

In the period 2016-2017 the growth of the main macroeconomic indicators was observed. We will carry out a factor analysis of the income from oil exports in this period.

1) determine the income from oil exports in actual prices for the base (2016) and reporting (2017).

- income from oil exports in the reporting period (Dan2017)

$$\text{Dan2017} = (370 * 58 - 17416) * 253 = 1023 \text{ billion rubles.}$$

- income from oil exports in the base period (Dan2016)

$$\text{Dan2016} = (288 * 67 - 12607) * 255 = 1706 \text{ billion rubles.}$$

2) Next step, we will determine the deviation of income from oil exports ( $\Delta \text{Dan}$ ):

$$\Delta \text{Dan} = \text{Dan2017} - \text{Dan2016} = 1023 - 1706 = -683 \text{ billion rubles.}$$

3) After the difference between the value of the oil export revenue in the base and the reporting period is determined, it is necessary to identify the factors that have had a positive and negative impact on the change in this indicator:

a) the first condition - we change the basic value of the volume of oil exports to the actual:

$$\text{Dan1con} = (288 * 67 - 12607) * 253 = 1692 \text{ billion rubles.}$$

b) the second condition - we change the basic value of the price of 1 ton of oil exports in US dollars to the actual value, while the value of the volume of oil exports remains in the actual value:

$$\text{Dan2con} = (370 * 67 - 12607) * 253 = 3082 \text{ billion rubles.}$$

c) the third condition - we change the basic value of the exchange rate of US dollar in Russian rubles to the actual, while the previous factors remain in actual values:

$$\text{Dan3con} = (370 * 58 - 12607) * 253 = 2240 \text{ billion rubles.}$$

5) After determining the intermediate values of the factors studied, we determine the impact of each factor analyzed on the result:

a) the impact of the change in the volume of oil exports on the change in income from oil exports in the reporting period:

$$\Delta \text{Denv} = 1692 - 1706 = -14 \text{ billion rubles.}$$

b) the impact of the change in the price of 1 tonne of oil in US dollars on the change in income from oil exports in the reporting period:

$\Delta \text{DanP} = 3082 - 1692 = 1390$  billion rubles.

c) the impact of a change in the exchange rate of US \$ in Russian rubles on the change in income from oil exports in the reporting period:

$\Delta \text{Dan } \$ = 2240 - 3082 = -842$  billion rubles.

d) the impact of a change in the cost of 1 ton of oil on the change in income from oil exports in the reporting period:

$\Delta \text{DanC} = 1023 - 2240 = -1217$  billion rubles.

6) Next, we determine the cumulative effect of all the factors studied, on the change in the indicator:

$\Delta \text{Dan} = (-14) + 1390 + (-842) + (-1217) = -683$  billion rubles.

Let us summarize the results of the deterministic factorial analysis of oil export revenues for the period from 2014 to 2017. in the comparative-analytical table 2.

Table 2 - Comparative-analytical table of the results of deterministic factor analysis of oil export income

№	Indicators	2014/2015 r.	2015/2016 r.	2016/2017 r.
I	Rejection of income from oil exports, total (billion rubles.), including due to:	-1060	-982	-683
a	changes in the volume of oil exports	370	108	-14
б	changes in the price of 1 ton of oil in US dollars	-3077	-1228	1390
B	changes in the exchange rate of 1 US dollar in Russian rubles	1978	440	-842
Г	changes in the cost of 1 ton of oil	-331	-304	-1217

On the basis of Table. 1 and 2, the following conclusions can be drawn:

- throughout the analyzed period, there was a decrease in income from oil exports;

in the period of the beginning of the economic crisis (2014-2015), one can note the most significant decline in oil revenues, which amounted to 1060 billion rubles. The greatest impact on this change was the decrease in the price of 1 ton of oil in the foreign market by \$ 322 - in this case, the losses from exports amounted to 3,077 billion rubles. The growth of the US dollar rate in Russian rubles by 22 rubles led to an increase in oil export revenues by 1978 billion rubles. - which allowed some to level this circumstance. Due to an increase in the volume of oil exports by 22 million tons per year, it was possible to block the negative impact of growth in the cost of production of 1 ton of oil to 11417 rubles;

- analyzing the period from 2015 to 2016 it is possible to note a decrease in oil revenues by 982 billion rubles. due to two factors: reducing the price of 1 ton of oil on the world stage to 288 US dollars and increasing the cost of 1 ton of oil to 12,607 rubles;

- in the period from 2016 to 2017 despite the increase in the price of 1 ton of oil in the foreign market to 370 dollars, there is a decrease in other factors. To a greater extent, the negative impact on the resultant indicator was made by the growth of the cost of 1 ton of oil to 17416 rubles.

#### CONCLUSION

As a result of studying methodological issues of research on export efficiency based on the example of Russia's oil industry, it can be noted that using deterministic factor analysis by the chain substitution method it is possible to identify reserves for improving the efficiency of Russia's foreign economic activity. Using the results of the proposed approach, the management decisions of the financial and economic services of the oil industry organizations in the field of prices and export volumes can be refined and adjusted.

Also, the results of this analysis can be used by the Ministry of Economic Development of the Russian Federation in analyzing and assessing the country's foreign trade balance and budget.

#### References

- [1] Information and analytical portal "Oil of Russia" [Electronic resource] - Access mode: <http://www.oilru.com/>
- [2] Kozhubayev, AG Problems and prospects of oil and gas exports from Russia to China / Contemporary Studies of Social Problems, 2010, No. 4.1 (04).
- [3] The Tax Code of the Russian Federation (part 1 and 2) of July 31, 1998 N 146-FZ.
- [4] Fedorov E.S. PROBLEMS AND PROSPECTS OF RUSSIAN EXPORT OF OIL // International Student Scientific Bulletin. - 2017. - No. 3.G. Eason, B. Noble, and I.N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529-551, April 1955. (references)
- [5] Official website of the Ministry of Finance of the Russian Federation <https://www.minfin.ru>
- [6] Official website of the Ministry of Economic Development of the Russian Federation <http://economy.gov.ru>
- [7] Official site of TASS news agency <http://tass.ru>
- [8] Official website of the International Energy Agency [www.iea.org](http://www.iea.org)
- [9] Official site of the Central Bank of the Russian Federation <https://www.cbr.ru>
- [10] Official website of the Federal State Statistics Service <http://www.gks.ru>
- [11] Official website of the Russian newspaper <https://rg.ru>