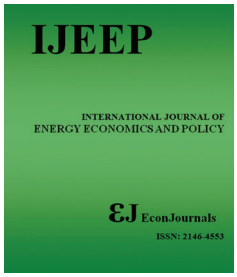

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Financial Risks of Russian Oil Companies in Conditions of Volatility of Global Oil Prices

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ABSTRACT

The development of scientific approaches to assessing and diagnosing the financial risks of oil industry in the Russian Federation becomes a high priority task in conditions of high level of volatility in oil prices in the world energy market and preservation of sanctions regime. The article shows the main threats to financial stability of oil companies in Russia. Using cluster analysis, a system of indicators is proposed that determines the level of financial risk of oil companies in Russia. Based on the method of expert assessments and fuzzy sets, the classification of financial risk levels of oil industry is proposed. The integrated financial risk level of oil industry was calculated and scenarios of its development for 2018-2020 were forecast by means of regression modeling. The system of measures to improve the stability of oil companies and prevent functional financial risks is argued. The practical implementation of research results will be the basis for timely diagnosis of financial risks and qualitative development of preventive measures to neutralize them in the oil industry of Russia.

Keywords: Oil Industry, Oil Companies, Financial Risks, Oil Prices, Financial Stability of Oil Industry
JEL Classifications: Q43, Q41, G32, L52

1. INTRODUCTION

Russia ranks sixth in the world as to oil reserves. Overall, the country's total oil reserves are estimated at 106.2 billion barrels of oil (BP Energy Economics, 2017). The extracted oil reserves amount to about 29 billion tons. In 2017, exports of crude oil and petroleum products amounted to almost 70% of total production volume of Russian petroleum liquids, constituting about 60% of the total Russian exports. In addition to production, there is also increase in demand for Russian raw materials. Thus, Russian oil exports increased by 7.3% during 2013-2017 (ME RF, 2018). These trends demonstrate the financial stability of the Russian oil industry. Even so, it should be emphasized that this stability is predetermined by combination of factors that determine the specifics of functioning of this sector of economy (Takhumova et al, 2018; Andreassen, 2016). However, there are significant financial risks - volatility of worldwide oil prices - which in the long run, can destructively affect the stability of oil industry in Russia. Thus, over the period from 2013 to January-August of 2018, Brent crude oil price declined by 31% (BP Energy Economics, 2018). The more unpredictable raw materials prices are, the more actively investments in long-term projects are limited, focusing on projects designed to extract profits in the short term as less exposed to financial risks. This trend eliminates the promising possibility of active investment in long-term exploration of new oil fields. Taking into account the fact that today the volume of proven extracted oil

reserves is approximately 14 billion tons, with other conditions being equal, the economic life of oil production in Russia will take about 28 years (Open Media, 2018). In addition, the production of 80% of oil reserves in the open new oil fields with the existing level of oil prices seems unprofitable. As experts note, it will be advantageous to extract oil at new fields, mainly offshore, only at the oil price of $ 70 per barrel (Lo, 2018; Wang and Ma, 2018).

Under current conditions, Russian oil companies should rely solely on their own strengths and means, so in the near future, the world oil price is projected at $ 70 per barrel (Focus Economics, 2018). The volatility of raw materials prices in the world market reduces the liquidity of the national exchange oil market. They provoke clotting of the volume of state support for new projects and increase financial risks of revising the tax system in direction of increasing the burden on the oil industry (FZ-199, 2018).

As a result, the Russian oil industry may face a slowdown in investments and significant revision of medium and long-term development plans, and for some companies the abandonment of expensive projects as well (ACRA, 2018). In this regard, developing scientific approaches to assessing the financial risks of oil companies in Russia under conditions of world oil prices volatility becomes a high priority issue.

The purpose of the article is to assess the financial risks of leading companies in the oil industry of Russia in conditions of oil prices volatility and sanctions toughening.

In the course of the study, the following tasks have been solved: The system of representative indicators of Russian oil companies was determined to assess financial risk; both qualitative and quantitative levels of financial risk of oil companies in Russia were determined and argued; the main factors of financial risk of the oil industry were justified; forecast scenarios were developed and possible directions for reducing the financial risks of oil companies were proposed.

2. MATERIALS AND METHODS

The study used such methods of scientific learning as:

- Cluster analysis
- Expert assessment method,
- Fuzzy sets,
- Extrapolation method
- Correlation and regression analysis.

The principle of clustering is to combine objects into groups in such a way as to minimize the distance between the objects that form a single cluster and maximize the distance between the clusters. The Euclidean distance is the distance measure (Zhu and Ma, 2018):

$$d_{ij} = \sqrt{\sum_{k}^{n}(x_{ik} - x_{jk})^2} \quad (1)$$

Where d_{ij} is a distance between the i-th and the j-th objects;
x_{ik}- value of the k-th indicator of i-th object;
x_{jk} - value of the k-th indicator of the j-th object center.

In the study, this method was used to group indicators of oil companies' financial risk with further definition of the cluster representative - the indicators that have a minimum distance to the cluster center.

To assess the quality of clustering, the indicators of intragroup (2) and intergroup (3) dispersion and Fisher criterion (4) are used (Zhu and Ma, 2018):

$$\sigma_j^2 = \frac{\sum_i^n (x_{ik} - \overline{x_{jk}})^2}{n_j} \quad (2)$$

$$\sigma^2 = \frac{\sum_i^n (\overline{x_{jk}} - \tilde{X}_k)^2 n_j}{N} \quad (3)$$

Where Q_j^2 is the intragroup dispersion of the j-th cluster;
σ^2- the intergroup dispersion;
x_{ik} - value of the k-th indicator of the i-th object;
$\overline{x_{jk}}$ - mean value of the k-th indicator of the j-th cluster;
$\tilde{X}_k$ - mean value of the k-th indicator of the sample;
n_j- the number of objects of j-th cluster
N - sample size

$$F_e = \frac{R^2}{1-R^2} * \frac{(n-m-1)}{m} \quad (4)$$

Where F_e is an empirical value of the Fisher criterion;
R^2- coefficient of multiple determination;
n - number of observations;
m- number of indicators.

In order to determine the classification levels of oil companies' financial risk and the quantitative limits of financial indicators that correspond to these levels, the fuzzy sets method is used, supported by expert assessment.

The Mamdani's algorithm is chosen of the algorithms implemented by the fuzzy sets method, which algorithm consists in converting quantitative values of financial indicators into fuzzy subsets, according to which the conclusion about the level of the resulting indicator is formed - the financial risk level (Yazdanbakhsh and Dick, 2018).

A trapezoid membership function is used hereinafter to show belonging of financial indicators to a fuzzy subset with the purpose of determining a number of financial indicators (Yazdanbakhsh and Dick, 2018):

$$f(x;a,b,c,d) = \begin{cases} 0, & and x \le a \\ \frac{x-a}{b-a}, & and a \le x \le b \\ 1, & and b \le x \le c \\ \frac{d-x}{d-c}, & and c \le x \le d \\ 0, & and d \le x \end{cases} \quad (5)$$

Where *f(x;a,b,c,d)* is a trapezoidal membership function;

a,b,c,d-quantitative parameters of the levels of indicators ordered by inequality $a \le b \le c \le d$.

The expediency of using fuzzy sets to determine the level of a company's financial risk is conditioned by the fact that when finding the integral indicator by multiplicative or additive convolution, it is possible to eliminate the low level of one indicator by the high value of another, and for the company's financial state a failure of noncompliance with one of the standards may carry significant financial risk.

In order to exclude extreme values, the study used the Dixon coefficient to check the maximum value (equation 6) and the minimum value (equation 7) (Rousseau et al., 2018):

$$r_{i,j} = \frac{x_n - x_{n-i}}{x_n - x_{j+1}} \quad (6)$$

$$r_{i,j} = \frac{x_{1+i} - x_1}{x_{n-j} - x_1} \quad (7)$$

Where $r_{i,j}$ are empirical values of the Dixon test;

$x_1, x_n, x_{n-i}, x_{j+1}, x_{1+j}, x_{n-j}$ - members of the variational series $x_1 \le x_2 \le x_3 \ldots \le x_i \ldots \le x_n$

The null hypothesis about the absence of extreme values is confirmed provided that the empirical value of the Dixon criterion is less than the tabulated value.

Along with fuzzy sets, the expert assessment method was used to determine the boundaries of financial indicator levels. The coefficient of competence (equation 8) (Tikhomirova and Matrosova, 2016) and the level of opinion consistency (equation 9) (Rousseau et al., 2018) indicate representativeness of the expert assessment results:

$$K_i = \frac{\sum_{i=1}^{m} e_{ij}}{m} \quad (8)$$

Where K_i is the coefficient of competence of the *i*-th expert;

e_{ij} - expert evaluations corresponding to the value "0," if the expert considers another one to be incompetent and does not see the expediency of his inclusion in the expert group, and "1," if the expert expressed the need to include another expert in the group;

m- the number of experts.

$$v = \frac{\sigma}{\bar{x}} * 100\% \quad (9)$$

Where *v* is the coefficient of variation of expert estimates;

σ- standard deviation of expert estimates;

$\bar{x}$ - arithmetic mean of expert estimates.

With $v \le 10\%$, experts' estimates are poorly variable, that is, there is a high degree of opinion consistency; at $10 < v \le 20\%$ they are moderately variable; being highly variable at $v > 20\%$, when the degree of expert opinion consistency is low.

The extrapolation method was used to predict macroeconomic indicators that affect the company's financial risk level. Extrapolation is a research method in which the forecast values of indicators are found proceeding from the historical trend. The extrapolation can be based on linear, power, logarithmic, polynomial, and other types of the indicator value dependence on the period. In general, the extrapolation model is described by function (Dokuchaev, 2018):

$$\hat{Y}_{t+l} = f(Y_{t,l}) \quad (10)$$

Where $\hat{Y}_{t+l}$ is the extrapolated value of the indicator *Y*;

Y_t- base level of the indicator;

l- forecast period.

Correlation and regression analysis - the analysis that was used to construct models of dependence of financial performance of oil companies on the integrated systemic risk indicator. In general, the linear multifactorial regression model has the form (Mishra and Datta-Gupta, 2018):

$$y = b_0 + b_1 * x_1 + b_2 * x_2 + \ldots + b_n * x_n, \quad (11)$$

Where *y* is a dependent variable;

$x_{1,\ldots,n}$- independent variables

b_0- a free member;

$b_{1,\ldots,n}$- independent variable held constants;

The regression model parameters of (b_0, $b_{1,\ldots,n}$) were estimated by the method of least squares. Its essence lies in the selection of model parameters with which the sum of the squared difference between the observed and forecast values of dependent variable is minimized (Mishra and Datta-Gupta, 2018):

$$\sum_i^N (y_i - \overline{y_i})^2 \to min \quad (12)$$

Where y_i is an actual value of the dependent variable at the *i*-th period;

$\overline{y_i}$ - a forecast value of the dependent variable at the *i*-th period;

$i=1,2,\ldots,N$.

3. RESULTS

Since the risk arises in conditions of uncertainty, the level of companies' financial risk directly depends on the level of product price volatility. To determine the level of Russian companies' risk associated with changes in the price level, let us estimate the volatility of world prices for oil and gas. Since the main part of energy resources of the Russian Federation is exported (54.28% of energy production volumes on average for 2013-2017), the volatility of world oil prices is one of the major financial risks in the activities of Russian oil companies. Despite the fact that Urals crude oil is mainly produced in the Russian Federation, the prices for petroleum products are influenced by the world level of prices for Brent crude oil (Investing.com, 2018).

For the period of 1990 - January-August of 2018, the calculated coefficient of variation of the average level of prices for Brent crude oil was 68.57% and that for natural gas was 55.3%. The values of coefficients of variation exceeding 20% indicate the high volatility of world prices for energy resources as well as the high level of financial risk associated with changes in the price level. The oil price has greater significance for the coefficient of variation, exceeding the level of variation in natural gas prices by 13.26 %. Even more significant differences in the level of variation in prices for these energy resources have been observed for the past 5 years: 43.37% for oil prices versus 20.81% for gas prices (Investing.com, 2018). Taking into account the given indicators of variation, it can be concluded that the main threat to the financial security of energy sector and its companies is created by the oil price volatility. The increase in world oil prices leads to increase in net exports, budget revenues and Russia's gross domestic product (GDP), while decrease causes reduction in foreign exchange earnings and decrease in GDP. The initial stage of modeling the influence of world prices on the level of financial risk of companies is to determine the indicators of companies' financial risk.

The largest oil companies of Russia were selected for the analysis, some of which are consistently profitable; others are not characterized by constant profitability and alternate profits with losses. Financially stable and unstable enterprises were selected for the analysis to determine the possible levels of financial risk for the companies by using the financial indicators for these two groups.

The selection of the group of enterprises for the study was carried out by experts who were asked to evaluate the feasibility of including the list of oil enterprises in the study using 5-point scale. Ten specialists from the Ministry of Energy of the Russian Federation were the experts in this case, including those from the Department of State Energy Policy, the Department of Corporate Governance, Pricing Environment and Audit in the Energy Industry, the Oil Refining and Gas Processing Department, the Oil and Gas Production and Transportation Department, the Department of Operational Control and Management in Electric Power Industry.

All experts pointed to the need of including the enterprises of Rosneft PJSC, Irkutsk Oil Company LLC, Gazprom Neft PJSC, Lukoil PJSC, Transneft PJSC, Nenets Oil Company JSC, Surgutneftegas OJSC in the analysis by giving them rating of "5". For other enterprises, the assessment of feasibility was lower.

In addition to assessing the feasibility of including enterprises in the analysis, the experts also evaluated their representativeness. The representativeness assessment was 96% of maximum possible. This indicates that it can be argued with the probability of 96% that the sample of enterprises is representative, with statistically significant level of 95%.

The degree of expert opinion consistency was assessed by the variation index (equation 9), which made 7%. This indicates low variability of expert estimates, and thus, a high level of consistency of their opinions.

The values of 45 financial indicators of the above mentioned Russian energy companies were taken as the empirical base of research (Rosneft Oil Company PJSC, 2018; Irkutsk Oil Company LLC, 2018; Gazpromneft PJSC, 2018; Lukoil PJSC, 2018; Transneft PJSC, 2018; Nenets Oil Company JSC, 2018; Surgutneftegas OJSC, 2018). Analysis of profitable and unprofitable companies will allow the study to cover the "high" level of financial risk inherent in loss-making companies, and the "low" level inherent in profitable ones, as well as provide sample representativeness as a result of including companies with different financial status therein.

The groups of indicators of the oil companies' financial risk level are determined using the cluster analysis method (hierarchical classification and *k*-means clustering) in Statistica 13.2 software package (Figure 1) based on 15 key financial performance indicators of enterprises (Santis et al., 2016):

- K1 - the current assets to equity ratio;
- K2 - the current assets coverage ratio;
- K3 - the net profit margin;
- K4 - the absolute liquidity ratio;
- K5 - the leverage ratio;
- K6 - the capital mobility ratio;
- K7 - the asset turnover ratio;
- K8 - the fixed-asset turnover ratio;
- K9 - the property profit margin;
- K10 - the operating expense ratio;
- K11 - the equity-assets ratio;
- K12 - the quick (acid-test) ratio;
- K13 - the current ratio;
- K14 - the current-asset turnover ratio;
- K15 - the current-asset profit margin.

For analyzing the oil companies' financial risk, four clusters are the sufficient sample for analysis, where the 1st cluster covered K1-K2, K6-K10, K12-K15 ratios; the 2nd cluster included K3; the 3rd cluster - K4; the 4th cluster K5 and K11. The *k*-means method was used to confirm the results obtained by the hierarchical clustering method and to determine the representative indicators of clusters.

The excess of intergroup dispersion indicators (Between SS) over intra-group (WithinSS) indicators and the excess of the calculated

Figure 1: Clustering tree diagram for Russian oil companies' financial performance indicators

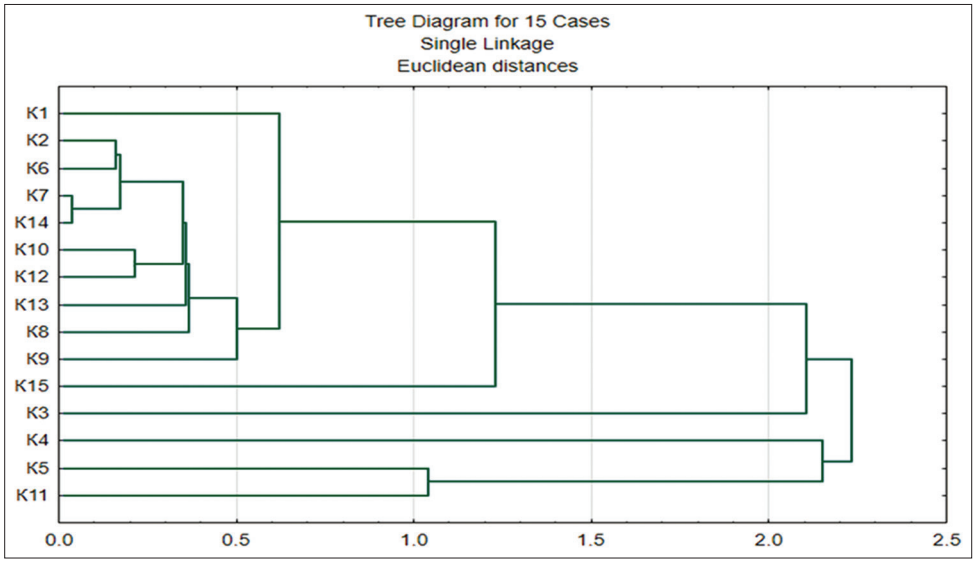


Figure 2: Dispersive analysis of the results of clustering the financial performance indicators

Variable	Analysis of Variance Between SS	df	Within SS	df	F	signif. p	Variable	Analysis of Variance Between SS	df	Within SS	df	F	signif. p
1	4.380973	3	0.812960	11	19.75936	0.000098	23	7.951510	3	5.651870	11	15.98423	0.000436
2	2.365478	3	1.956154	11	12.26845	0.000999	24	13.517400	3	9.129795	11	73.98457	0.000000
3	1.365895	3	1.213548	11	17.65489	0.000292	25	6.484996	3	3.617979	11	17.53651	0.000302
4	11.325640	3	8.641515	11	10.52365	0.001570	26	9.123136	3	2.856279	11	77.00398	0.000000
5	8.323684	3	6.315533	11	56.31487	0.000000	27	1.368465	3	0.683450	11	63.14757	0.000000
6	4.369124	3	2.698410	11	46.96545	0.000000	28	6.185562	3	1.952557	11	14.32168	0.000598
7	2.987011	3	1.358416	11	10.03536	0.001999	29	6.864537	3	5.483400	11	28.00063	0.000040
8	1.326549	3	0.697252	11	53.15896	0.000000	30	5.288747	3	0.339845	11	86.31541	0.000000
9	2.365412	3	1.848263	11	19.85936	0.000078	31	6.345879	3	5.579981	11	20.02333	0.000054
10	3.999542	3	3.268416	11	48.32664	0.000000	32	14.923478	3	2.683467	11	52.33840	0.000000
11	5.365232	3	4.684300	11	44.69855	0.000001	33	3.853430	3	1.135419	11	86.98426	0.000000
12	9.623943	3	9.613268	11	59.32384	0.000000	34	6.575282	3	2.625451	11	56.97424	0.000000
13	10.326578	3	5.381270	11	62.36844	0.000000	35	2.595617	3	1.689400	11	85.98724	0.000000
14	11.956442	3	8.514879	11	84.64789	0.000000	36	1.365464	3	0.675100	11	13.35963	0.000799
15	5.154498	3	3.214756	11	28.66126	0.000033	37	3.843912	3	1.340000	11	36.56288	0.000005
16	1.987633	3	1.655976	11	19.95315	0.000074	38	0.986156	3	0.233999	11	56.32166	0.000000
17	3.465842	3	2.397494	11	18.65146	0.000109	39	9.032188	3	5.369874	11	68.97526	0.000000
18	8.241994	3	8.013697	11	13.36545	0.000827	40	11.943046	3	8.138457	11	53.97166	0.000000
19	21.396548	3	19.587170	11	89.21566	0.000000	41	16.264792	3	15.979111	11	61.32267	0.000000
20	0.986257	3	0.232673	11	19.90999	0.000064	42	2.641999	3	1.236658	11	12.36545	0.000983
21	2.684560	3	0.698711	11	63.87896	0.000000	43	9.334333	3	3.217960	11	10.63590	0.001400
22	6.845650	3	0.156498	11	77.98465	0.000000	44	6.462187	3	0.683707	11	34.65622	0.000007
							45	9.470417	3	0.406156	11	85.49631	0.000000

values of the Fisher criterion (F) over the tabular value (3.59) of the error level (signif.p), which tends to "0", indicates the adequacy of the clustering results and feasibility of identifying four clusters (Figure 2).

Representative indicators were identified from each cluster based on minimizing the Euclidean distance between each data point and the cluster center. These indicators representing the level of financial risk at an enterprise are the current ratio (cluster 1), the net profit margin (cluster 2), and absolute liquidity ratio (cluster 3). Cluster 4 consists of two indicators that have equal distance to the center; therefore, the indicator was selected from this cluster that has the greatest distance to the centers of other clusters - the equity-assets ratio.

The identification of indicators of the financial risk level from the totality of all financial performance indicators allowed increasing the accuracy of calculations by eliminating multicollinearity between indicators within each cluster. At the same time, the list of indicators was formed by financial soundness indicators, liquidity ratios and profit margins, which comprehensively describe the financial condition of an enterprise and determine the likelihood of enterprise insolvency under the threat of financial risk (Florio and Leoni, 2017).

When studying the theory of risks, the acceptable, critical and catastrophic levels of risk are distinguished in the economic literature (Battiston and Martinez-Jaramillo, 2018). This research used the method of fuzzy sets, which allows developing the levels of indicators and rules for identifying the financial risk levels of oil companies based on statistical data and expert opinions. The incoming dataset for building a model to identify the financial risk level was formed using the values of current ratio (K13), net profit margin (K3), absolute liquidity ratio (K4) and equity-assets ratio (K11) of the studied companies for 2011-2017 based on their financial statements (Table 1) (Rosneft Oil Company PJSC, 2018; Irkutsk Oil Company LLC, 2018; Gazpromneft PJSC, 2018; Lukoil PJSC, 2018; Transneft PJSC, 2018; Nenets Oil Company

Table 1: Values of financial risk indicators of Russian oil companies

Calendar year	K3	K4	K11	K13	K3	K4	K11	K13
	Rosneft oil company PJSC				Transneft PJSC			
2011	0.1233	0.3747	0.6076	1.8916	0.0176	0.6231	0.1495	1.2710
2012	0.1182	0.6600	0.5847	2.0949	0.0155	0.3555	0.1594	0.9700
2013	0.1174	0.1983	0.4214	1.0490	0.0160	0.2705	0.1626	0.9393
2014	0.0636	0.1064	0.3298	1.0492	0.0164	0.2060	0.1379	0.6259
2015	0.0691	0.3076	0.3059	1.3231	0.0169	0.3246	0.1317	1.2771
2016	0.0385	0.2849	0.3402	0.8294	0.0381	0.1796	0.1647	0.8265
2017	0.0494	0.0839	0.3421	0.5975	0.0704	0.2137	0.1784	0.8680
	Irkutsk oil company LLC				Nenets Oil Company JSC			
2011	-	-	-	-	3.3535	0.1415	0.9183	11.3774
2012	0.3043	0.0393	0.3598	0.2878	0.1243	10.1205	0.9620	19.6867
2013	0.2995	0.0689	0.4013	0.2529	0.1048	3.7477	0.9596	11.7944
2014	0.2538	0.1125	0.3163	0.2872	0.0314	5.6718	0.8946	11.7252
2015	0.3582	0.0589	0.3721	0.3240	−0.6879	12.9191	0.6108	29.5775
2016	0.3803	0.1626	0.4306	0.3146	−1.0564	6.6505	0.6779	38.4706
2017	-	-	-	-	0.3446	0.9348	0.7071	11.4496
	Gazprom neft PJSC				Surgutneftegas OJSC			
2011	0.0929	0.0434	0.3893	1.9808	-	-	-	-
2012	0.0748	0.2338	0.4478	1.4222	-	-	-	-
2013	0.0570	0.2419	0.3385	1.4506	-	-	-	-
2014	0.0113	0.0549	0.2155	1.3758	1.0337	0.2408	0.9358	7.4543
2015	0.0127	0.1611	0.1656	1.1253	0.7681	0.5551	0.9457	6.5015
2016	0.0993	0.0134	0.2397	0.9437	−0.1055	0.3820	0.9470	7.4015
2017	0.1127	0.0541	0.2573	1.0808	0.1308	0.4731	0.9424	9.1470
	Lukoil PJSC							
2011	-	-	-	-				
2012	0.0791	0.2340	0.7472	7.9468				
2013	0.0554	0.1307	0.7198	8.3560				
2014	0.0719	0.2169	0.6426	1.5860				
2015	0.0506	0.3701	0.6430	1.7458				
2016	0.0396	0.3146	0.6432	1.5116				
2017	0.0705	0.3446	0.6674	1.3643				

JSC, 2018; Surgutneftegas OJSC, 2018). The outgoing variable of the model is the level of financial risk of the enterprise.

Since the outgoing variable has a discrete character, the Mamdani algorithm was used to build a model for identifying the level of financial risk, which transforms quantitative and qualitative indicators into levels using the fuzzy logic apparatus.

To determine the levels of financial indicators, the trinary scale was used, according to which the set of indicator values is divided into three levels: Low, medium and high. The trapezoidal function was chosen as a fuzzy subset membership function for all indicators. This is the most common function, which reflects the zone of complete confidence in the classification, and uncertainty gaps when it is impossible to give accurate estimates regarding the assignment of the indicator value to the specific term set of values. The analytical representation of the trapezoidal membership function is expressed by equation 5.

The selection of trapezoidal function is determined by the fact that the normative values of financial indicators do not have specifically expressed value, but are contained in the interval. The algorithm for determining fuzzy sets was implemented in the Matlab program. To determine the boundaries of the levels of financial indicators, the method of expert assessment was used. The expert group included 10 people: A Member of the Board of Directorsof Rosneft Oil Company PJSC; the Head of Finance Department ofIrkutsk Oil Company LLC; the Deputy Director General for Economics and Finance and the Director General for Economics and Finance of Gazprom Neft PJSC; Senior Vice President for Finance and the Chairman of the Strategy and Investment Committee of Lukoil PJSC; the Head of the Department of Internal Audit and Analysis of Core Business Activities and the Vice President of Transneft PJSC; the General Director ofNenets Oil Company JSC; Deputy General Director for Economics and Finance of Surgutneftegas OJSC.

The experts' competence is the main parameter for assessing the quality of expert evaluation, it is estimated by the coefficient of competence (K_i). Each expert gives the binary assessment of expediency of including other experts in the group. The "0" scoring means incompetence of the evaluated expert and unwillingness to include him in the expert group on the part of another expert; "1" implies high competence and the need to be included in the expert group.

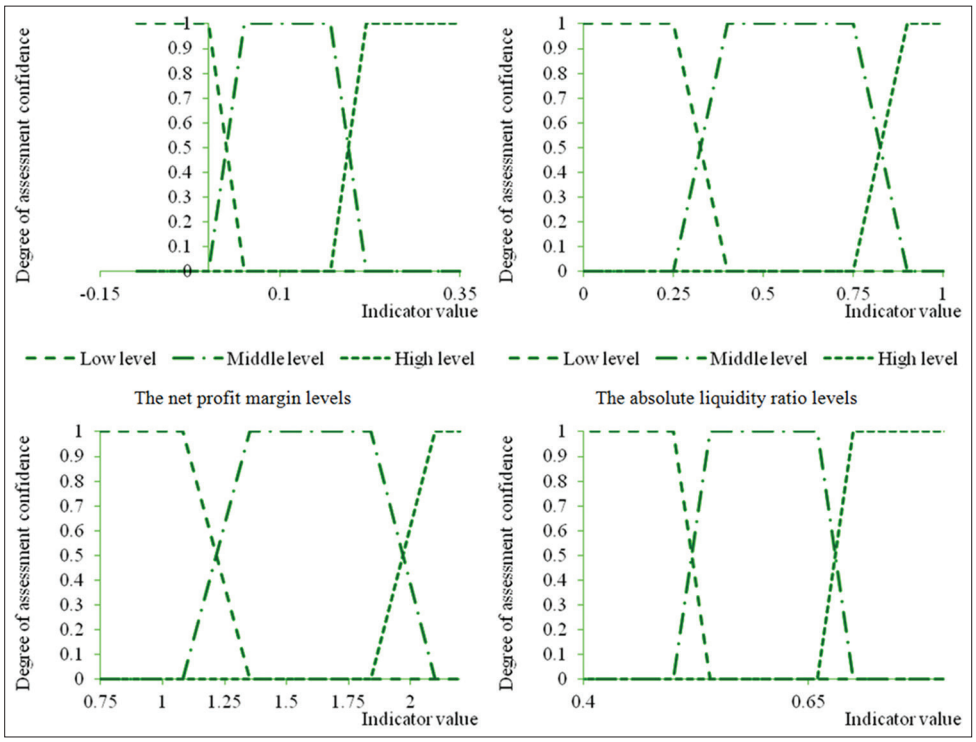
The coefficient of competence is calculated as the arithmetic mean of mutual evaluations of experts and is measured in the range [0, 1]. The higher the coefficient value, the more desirable the expert's participation in the survey is. The threshold value of the coefficient of competence, being sufficient for inclusion of the expert in the working group is 0.5. Indicators of the experts' competence level are given in Table. 2

For all experts who have formed the research group, the competence ratio was >0.5, which indicates the high competence of all survey

Table 2: The competence coefficients of experts evaluating financial risk in Russian oil industry

Experts	E 1	E 2	E 3	E 4	E 5	E 6	E 7	E 8	E 9	E 10
E 1	-	1	1	1	1	0	1	1	1	0
E 2	1	-	1	1	1	1	1	0	1	0
E 3	1	1	-	1	1	1	0	1	1	1
E 4	1	1	1	-	0	1	1	1	1	1
E 5	1	1	1	1	-	1	1	0	0	1
E 6	1	1	0	1	1	-	0	1	1	0
E 7	1	1	1	1	1	1	-	1	1	1
E 8	1	1	1	1	1	1	1	-	1	1
E 9	1	1	1	1	0	1	1	1	-	1
E 10	1	1	1	1	1	1	1	1	0	-
Sum of assessments	9	9	8	9	7	8	7	7	7	6
Competence coefficient	1	1	0.9	1	0.8	0.9	0.8	0.8	0.8	0.7

Figure 3: Classification of levels of financial risk indicators for oil companies with regard to the degree of assessment confidence



participants. The experts'' competence is confirmed by the fact that all of them are top managers and specialists of financial departments of enterprises for which the level of financial risk is assessed.

The level of expert opinion consistency on the marginal values of financial risk indicators of enterprises was estimated by the variation indicator, which varies in the range of 6-8%. The variation indicator value below 10% indicates a low degree of assessment variation, and therefore, the high degree of expert opinion consistency.

Classification of levels of financial risk indicators is given in Table 3 and Figure 3. The degree of assessment confidence reflects the probability of attributing the indicator value to the certain level.

The net profit margin on sales characterizes the profitability of the enterprise - the amount of monetary units of net profit which falls on the unit of net income. This indicator has no normative values; the higher the indicator value, the lower the financial risk level (Bamber et al., 2018). The inefficient use of enterprise resources is indicated by the negative value of the indicator at which the company incurs losses. Consequently, the values [−∞; 0] correspond to the low level of the indicator. The high level of indicator is determined proceeding from the mean value of the net profit margin on sales for the profitable enterprises under study: [0.23; + ∞]. The average level was determined by the program automatically based on the specified low and high levels of financial indicators [0; 0.05; 0.18; 0.23].

The absolute liquidity ratio characterizes the enterprise ability to settle its current liabilities at the expense of the most liquid assets. As the data of Table 1 show, the level of absolute liquidity is higher for unprofitable enterprises than for profitable ones (Cheng et al., 2018). This is explained by the fact that excessive accumulation of funds reduces the efficiency of the enterprise's activity due to shortfall of profit provided the investing these funds.

Table 3: Levels of financial risk indicators for oil enterprises

Financial risk indicator	Nodal points of indicator membership in the value level
Net profit margin	Low [−∞;−∞; 0; 0.05]; Middle [0; 0.05; 0.18; 0.23] High[0.18; 0.23; +∞; +∞]
Absolute liquidity ratio	Low [0; 0; 0.25; 0.42]; Middle [0.25; 0.42; 0.75; 0.93] High [0.75; 0.93; +∞; +∞]
Current ratio	Low [0; 0; 1.09; 1.24]; Middle [1.09; 1.24; 1.82; 2.09] High [1.82; 2.09; +∞; +∞]
Equity-assets ratio	Low [0; 0; 0.5; 0.54]; Middle [0.5; 0.54; 0.66; 0.7] High [0.66; 0.7; 1; 1]

The high level of indicator corresponds to the range [0.93; + ∞], where 0.93 is the maximum value of the ratio for profitable enterprises with the exception of extreme values, which, according to Dixon's criterion, are the values of 10.12, 3.75, 5.67. The value of 0.93 is the value at which a large number of liquid assets still do not threaten the profitability of the enterprise. The low level of indicator corresponds to the interval [0; 0.25], where 0.25 is the mean value of the absolute liquidity ratio for profitable enterprises. When determining the low level of indicator, the standard values of absolute liquidity ratio 0.2-0.35 were taken into account. Therefore, the low level determined using the MATLAB program is presented rather by medium-sized values of absolute liquidity ratio for profitable enterprises, than by minimal ones. The algorithm for determining the current ratio levels is similar: The low level ranging within [0; 1.09], with the normative level ranging from 1.5 to 2 and high level including the values of [2.09; + ∞].

The mean values of the equity-assets ratio for profitable and unprofitable enterprises do not differ significantly; therefore, the mean value for the studied enterprises (0.5) was used as the maximum boundary of the low level of the equity-assets ratio, which corresponds to the minimum permissible standard value of the indicator. Since there are no differences in the values of indicators for profitable and unprofitable enterprises, there is no threshold value for the transition from effective management of capital structure to inefficient one. Therefore, the experts defined the minimum boundary of the high level of the equity-assets ratio as 0.7, taking into account that the standard values of this indicator, shown in the economic literature, make 0.5-0.7 (Silva et al., 2017).

The next step in assessing the financial risk level was to determine the rules for its identification, based on the level of financial indicators.

Identification rules are formed by conducting experiments with the model: By selecting them so that the level of a company's financial risk, determined according to the presented classification rules, is as close as possible to the actual financial condition of the company (Orazalin and Mahmood, 2018).

The permissible level of financial risk is characterized by the company's profitable activity, high level of liquidity and financial stability. At this level the risk of activity is associated with the possibility of shortfall in profits due to poor management or negative impact of low level of oil prices. At the given level of financial risk, all financial ratios are at the average level with the possibility of deviation in the short term toward the high level.

The critical level of financial risk reflects the unprofitable activity of a company, but may be accompanied by the high level of liquidity. The critical financial risk is characterized by the low level of net profit margins on sales, the low level of the equity-assets ratio, mostly the low or medium level of absolute and current liquidity.

The catastrophic level of financial risk creates the risk of bankruptcy as a result of inefficient use of equity funds. The company runs the risk of losing its equity capital. This level of financial risk is characterized by the low level of net profit margins on sales, low level of the equity-assets ratio, low level of current liquidity, and low or medium level of absolute liquidity. The absolute liquidity ratio may be at the medium level as a result of temporary cash receipts, but the amount of liquid funds is not enough to cover current liabilities.

Provided that financial indicators are at the high level, financial risk does not pose a threat to the company.

The financial sustainability of oil enterprises is influenced by the world level of oil prices, volume of investment in the industry, demand for oil, and volume of oil production (Orazalin and Mahmood, 2018). Since these variables have different dimensions and degree of influence on the companies' financial condition, the indicator of the integral level of systemic risk is calculated on the basis of indicators of dynamics of variables, taking into account their weighting factors.

The following indicators were used as variables:

- Growth rate of foreign direct investment (X1);
- Growth rate of proven oil reserves in the Russian Federation (X2);
- Growth rate of the global oil demand (X3);
- Growth rate of Russian oil exports (X4);
- Growth rate of the global price for Brent crude oil (X5);
- Growth rate of oil production in the Russian Federation (X6).

Since the bulk of the Russian oil is exported, the global oil demand growth rate was used in the study. Statistically the power of influence of the global demand on the financial condition of companies is more significant than that of the domestic one, as evidenced by the correlation coefficient. The average correlation coefficient between indicators of the companies' financial condition and the global demand is |0.76|, while between indicators of the companies' financial condition and the domestic demand it amounts to |0.53|.

Weighting significance factors for partial indicators of the risk level were determined on the basis of correlation coefficients between them and financial performance indicators of Rosneft Oil Company PJSC, Irkutsk Oil Company LLC, Gazprom Neft PJSC, Lukoil

Figure 4: Dynamics of actual and forecast indicators of financial risk for Russian oil companies

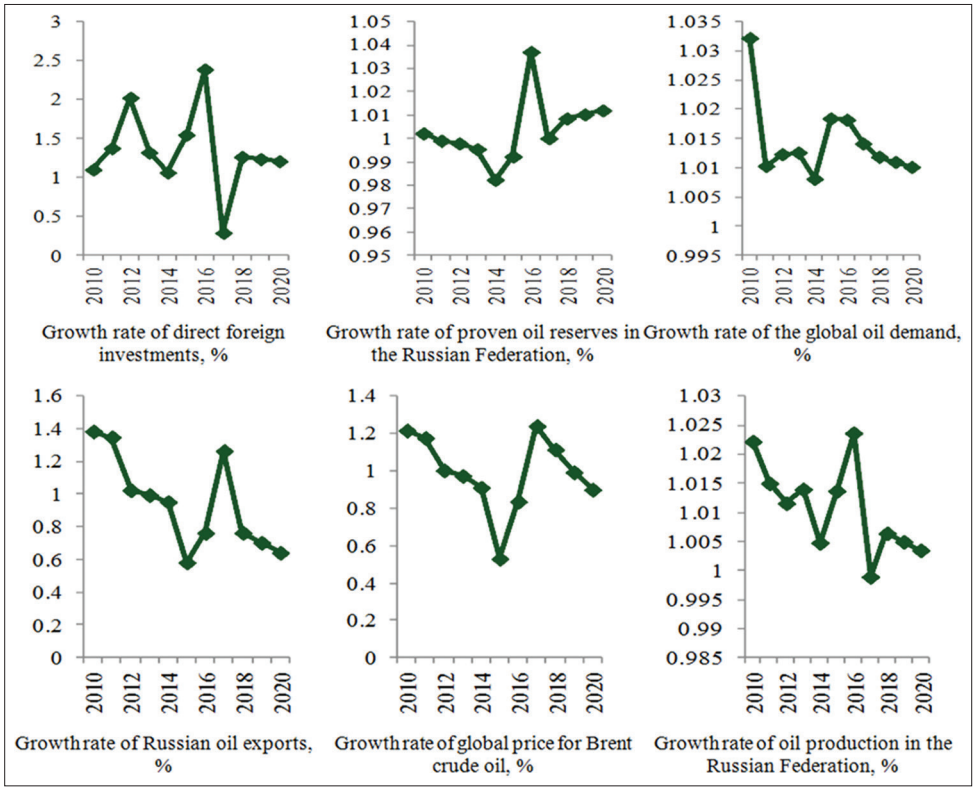


Table 4: Actual and forecast values of the integral risk index

Year	Value
2010	0.8823
2011	0.8634
2012	0.8959
2013	0.9582
2014	1.0227
2015	1.2841
2016	0.9825
2017	1.3767
2018	
Pessimistic forecast	1.0254
Realistic forecast	0.9741
Optimistic forecast	0.9278
2019	
Pessimistic forecast	1.0797
Realistic forecast	1.0257
Optimistic forecast	0.9769
2020	
Pessimistic forecast	1.1357
Realistic forecast	1.0789
Optimistic forecast	1.0275

PJSC, Transneft PJSC, Nenets Oil Company JSC, Surgutneftegas OJSC. Paired correlation coefficients were calculated for each oil company between the financial indicators K3, K4, K11, K13 on the one hand, and the macroeconomic and global indicators X1-X6, on the other hand. For each indicator X1-X6, the mean value of correlation coefficient was calculated for all indicators of all companies. The weighting factor of indicators X1-X6 was defined as a percentage of the average correlation coefficient for a separate indicator in the sum of correlation coefficients of all indicators. Thus, the weighting factors that correspond to the density of linkage of macroeconomic and global indicators with the oil companies' financial risk level included:

- Growth rate of foreign direct investment (X1) - 0.19;
- Growth rate of proven oil reserves in the Russian Federation (X2) - 0.06;
- Growth rate of global oil demand (X3) - 0.17;
- Growth rate of Russian oil exports (X4) - 0.15;
- Growth rate of the global price for Brent crude oil (X5) - 0.28;
- Growth rate of oil production in the Russian Federation (X6) - 0.15.

All indicators have direct impact on financial stability of the studied oil companies; therefore the integral risk index was calculated using the regression model.

$$I = 0.19\frac{1}{X1} + 0.06\frac{1}{X2} + 0.17\frac{1}{X3} + 0.15\frac{1}{X4} + 0.28\frac{1}{X5} + 0.15\frac{1}{X6}$$

To obtain the forecast value of the integral indicator of systemic risk and scenarios for oil companies' development, based on the actual data of indicators X1-X6 for 2010-2017, their value was predicted for 2018-2020 using the extrapolation method (BP Energy Economics, 2018; Investing.com, 2018; External Sector Statistics, 2018). The forecast was made for a short-term period, since the integral risk components depend not only on the economic environment of the energy market, but also are subject to the significant influence of the political factor. The dynamics of actual and forecast indicators is shown in Figure 4.

Table 5: Regression models of companies' financial performance versus the integrated systemic risk index

Company	Dependence equation			
Rosneft oil company	K3=0.21-0.14*I	K4=0.56-0.43*I	K11=0.88-0.45*I	K13=2.44-1.69*I
Gazprom neft	K3=0.27-0.11*I	K4=0.34-0.24*I	K11=0.44-0.16*I	K13=2.07-0.88*I
Lukoil	K3=0.19-0.09*I	K4=0.61-0.24*I	K11=0.84-0.14*I	K13=1.53-0.15*I
Transneft	K3=0.44-0.34*I	K4=0.39-0.11*I	K11=0.3-0.09*I	K13=1.37-0.47*I
Nenets oil company	K3=1.16-0.81*I	K4=1.38-0.43*I	K11=1.41-0.65*I	K13=14.86-2.84*I
Surgutneftegas	K3=0.49-0.34*I	K4=0.81-0.29*I	K11=1.04-0.08*I	K13=10.3-1.05*I

Table 6: Scenario forecast level of the integral financial risk of Russian oil companies

Company	Actual risk level, 2017	Forecast level of risk								
		2018			2019			2020		
		Pessimistic forecast	Realistic forecast	Optimistic forecast	Pessimistic forecast	Realistic forecast	Optimistic forecast	Pessimistic forecast	Realistic forecast	Optimistic forecast
Rosneft oil company	C	C	C	C	C	C	C	C	C	C
Gazprom neft	C	P	P	P	P	P	P	P	P	P
Lukoil	P	P	P	P	P	P	P	P	P	P
Transneft	C	C	C	P	C	C	C	C	C	C
Nenets oil company	P	P	P	P	P	P	P	P	P	P
Surgutneftegas	P	P	P	P	P	P	P	P	P	P

Designations: P: Permissible level of financial risk; C: Critical level of financial risk; Ct: Catastrophic level of financial risk

The calculated forecast values of the indicators correspond to the realistic development scenario. The pessimistic and optimistic scenarios were built taking into account a permissible deviation of the actual data from the forecast (5%). The pessimistic scenario is the deviation of the indicator growth rates from the realistic scenario by 5% downwards; while the optimistic scenario implies 5% upwards from the realistic scenario.

The values of the integral risk index, calculated by the equation (1) with regard to the forecast values of partial indicators, are given in Table. 4.

The conclusions can be drawn as to the forecasts of integral indicator of financial risk for 2018-2020. The 2018-2020 risk level is forecast to be lower relative to the level of 2017. According to the pessimistic scenario, the financial risk of the oil industry will decrease by 26% in 2018 relative to 2017, by 22% in 2019 and by 18% in 2020. According to the realistic scenario financial risk will decrease by 29% in 2018 as compared to 2017, by 26% in 2019 and by 22% in 2020. According to the optimistic forecast, financial risk will decrease by 33% in 2018 relative to 2017, by 29% in 2019 and by 25% in 2020.

To study in detail the change in the companies' financial risk level under various scenarios, a system of dependence equations has been developed using regression analysis for each of the studied oil companies (Table 5).

Adequacy of the obtained models of dependence of companies' financial performance indicators on the integrated systemic risk index is confirmed by the values of multiple correlation coefficients which tend to 1 for all models; by determination coefficients exceeding 0.8 and by Fisher's criterion, calculated values of which are higher than the tabular ones.

The change in the financial risk level of the studied companies under various development scenarios is given in Table 6.

4. DISCUSSION

The forecast dynamics of the integral level of financial risk reflects its positive trend for 2018-2020 in all development scenarios.

Based on the extrapolation (Figure 4), it was revealed that until 2020 the increase in the financial risk level in Russian oil sector will be caused by decrease in growth rates of foreign direct investment in the industry and the volume of demand for Russian oil in the world market, decrease in the growth rates of Russian oil exports and global prices for Brent crude oil, reduction in oil production in the Russian Federation.

The developed models of the integral financial risk influence on stability of the studied oil companies testify to their inverse proportionality. The decrease in all indicators, employed for the integral risk index calculation, leads to decrease in the net income of companies due to decrease in the price level of products sold, demand, production and export potential, and decrease in explored oil reserves. The decrease in revenues leads to decrease in the companies' net profit, liquid assets and decrease in financial stability, since net profit is the main source of financing for their operating activities.

For Rosneft Oil Company PJSC, the financial risk level remains at the critical level under all development scenarios. For Transneft PJSC the optimistic scenario predicts the decrease in the financial risk level to the acceptable level as a result of increase in absolute and current liquidity ratios.

For Gazprom Neft PJSC, as a result of predicted decrease in the integral indicator of systemic risk, the financial risk level will decrease from critical level to acceptable level. For Lukoil PJSC, Nenets Oil Company JSC and Surgutneftegas OJSC, the financial risk level is forecast at a constant level - that of permissible risk. For Irkutsk Oil Company LLC, the forecast for financial risk level

was not made, since there are no data on the company's financial statements for 2017.

As it was already noted in the study, the scenario forecast of the integral financial risk level in the Russian oil industry was carried out for the short-term period due to significant influence of the political factor on the companies' financial stability (economic sanctions of the European Union and the USA against Russia). To ensure the financial sustainability of oil companies' development in the Russian Federation, it is advisable to implement the following system of measures.

The oil industry is a strategic sector of the Russian economy, forming the predominant part of the federal budget revenues. In this regard, the state should carry out strategic innovative development of the industry, in particular:

- To expand funding for geological exploration in hard-to-reach regions, especially in the study of the Russian shelf;
- To create conditions for expansion of international collaboration and cooperation ties for joint exploration, development and production of oil in the Arctic shelf, conducted by the state and private companies;
- To increase international interaction for access to new advanced technologies of exploration, development and extraction of energy resources;
- To finance upgrading of the technologies for production of domestic specialized equipment for exploration, development and production of oil and other hydrocarbons;
- To ensure the development of scientific, design, engineering and production potential for economic development of oil production from hard-to-recover fields;
- To ensure the development and financing of scientific research in the field of analyzing and forecasting the features of development of global energy markets to work out and timely adjust the strategy on oil export policy;
- To revise multi-level tax system with the purpose of providing oil companies with the opportunity to accumulate money in accumulation funds, which can make it possible to revitalize the investment process in the industry at the expense of own savings of oil and gas producing companies.

At the micro level, for Russian oil companies, with the purpose of reducing the financial risk impact, it is advisable to implement a system of measures aimed at improving financial sustainability:

- Increasing the equity capital by reducing production costs and eliminating surplus inventories;
- Increasing equity capital by gains in authorized capital by means of lowering dividend payments and increasing retained earnings and reserves;
- Increasing production profitability by means of expanding oil sales markets in China; streamlining expenditures by reducing administrative costs; avoiding delays in debt payments; liquidating non-functional assets;
- Using borrowed funds within the normal range in relation to the amount of equity capital (50% to 50%), which will contribute to increase in revenue and reduction in the need for non-current assets;
- Upgrading the capacity of secondary oil production process to increase the depth of oil refining and to obtain additional volume of light petroleum products. By increasing the refining depth of oil from the current level of 62% to 80%, it is possible to obtain additional tons of light petroleum products, some of which may be exported.

5. CONCLUSION

Thus, the following conclusions can be drawn based on the developed approach to determining financial risk for Russian oil companies.

1. The study showed that, as of 2017, Rosneft Oil Company PJSC, Gazprom Neft PJSC and Transneft PJSC have a critical level of financial risk and are characterized by unprofitable operating activities, low level of net profit margins and the equity-assets ratios with high level of liquidity. For such oil companies as Lukoil PJSC, Nenets Oil Company JSC and Surgutneftegas OJSC, the level of financial risk is acceptable, that is, the companies are characterized by high level of liquidity and financial stability.
2. The presented regression model for calculating the integral level of financial risk in the Russian oil industry became the basis for its scenario forecasting for 2018-2020. It has been established that the financial risk of the industry has a positive development trend in optimistic, realistic and pessimistic forecast scenarios. The revealed trend of financial risk growth is caused primarily by the decrease in the level of oil prices, as well as by the related factors - the decreased direct investment in the industry, reduced proven oil reserves in Russia, and decrease in national oil exports.
3. The substantiated system of optimization measures is based on implementation of state innovation policy in the oil industry and efficiency improvement in financial policies of oil companies. The practical implementation of the proposed set of measures will contribute to improving the financial sustainability of oil enterprises in the Russian Federation.

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