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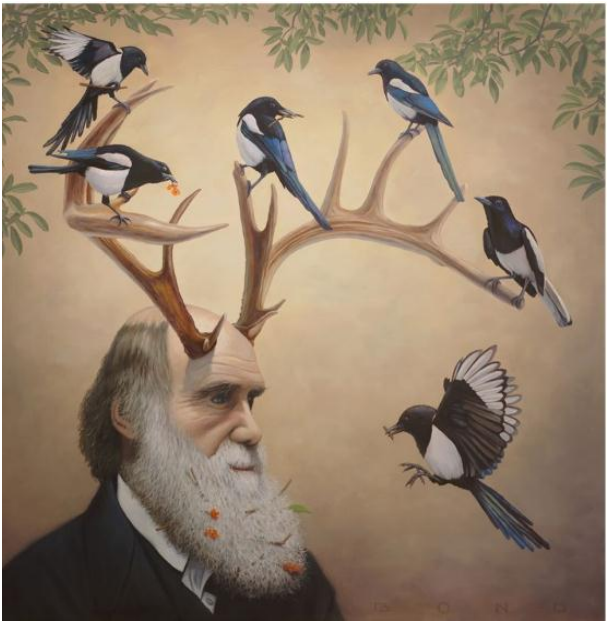

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Correlation And Regression Analysis For Researching Sustainable Development Of A Diversified Company

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Abstract

The research objective is to develop an approach to production diversification for oil companies under unstable global economy, changeful supply and demand for energy sources, and high oil prices. The study method is correlation and regression analysis that allows identifying the impact of certain factors on performance. The paper proposes an algorithm of such analysis that provides awareness, assessment, and risk reduction. Given that renewable power generation is seeing fast growth, diversification has become a promising direction for oil companies' development. It allows balancing risk and economic efficiency, assessing risks and making a forecast of future financial flows.

Keywords: business processes, capital increase, product diversification, strategic management, vertical integration.

Investigando Desarrollo Sostenible de Compañía Diversificada por Análisis de Correlación y Regresión

Resumen
Aquí se tiene por objetivo desarrollar un enfoque a la diversificación de producción en compañías petroleras en medio de inestabilidad económica global, oferta y demanda variables de fuentes energéticos y precios petroleros altos. Se realiza el estudio por análisis de correlación y regresión que permite evaluar el impacto de algunos factores en los resultados económicos. Aquí se propone un algoritmo de este análisis que facilita concienciación y evaluación y reducción de riesgos. Dado que se ve un crecimiento rápido de la generación de energías renovables, la diversificación se ha hecho un area de desarrollo prometedora para compañías petroleras y permite equilibrar riesgos con eficacia económica, evaluar riesgos y pronosticar flujos financieros.
Palabras clave: procesos comerciales, incremento de capital, diversificación de productos, gerencia estratégica, integración vertical

1. Introduction

With the development of economic relations, economists began to pay increasing attention to the problem of ensuring sustainable development of various economic systems.

It is important to study economic processes at the level of the main actor of any national economy – a company. It is necessary to find out at this level of management what are the prospects and the potential of each business entity in maintaining sustainable and efficient development of the national economy. It should be noted that the sustainable development of the national economy depends on solving these problems (Niazyan, 2015). The concept of diversification was acknowledged as a strategy that reduces the risk of market activity in adverse conditions and ensures better sustainability of a company (Ovsyannikov, 2017). At the same time, they all agree that the essence of diversification lies in the simultaneous development of many unrelated types of production, expansion of the range of manufactured products, and re-orientation of sales to new markets.

Analyzing the definitions of diversification, one may can notice that some of them focus on the very goal of diversification, i.e. reducing risks and losses of income or capital, while others focus on the ways to achieve the goal, i.e. acquiring a securities portfolio, expanding the scope of activities, penetrating new product markets, developing other areas of production,

etc. However, diversification has not been studied as an ongoing real-time market process that takes its course in actual life in the system of industrial entrepreneurship (Diversifikatsiya, n.d.).

2. Materials and methods

At the present stage, the company carries out its activities in a specific space-time context, in accordance with the current law; in other words, it acts as an economic unit. From the viewpoint of systems approach, each economic unit is a complex system of elements that united by a multitude of links to each other and also to the external environment. For the proposes of this research the company is viewed as a system, since the sustainability of the company is being analyzed and, therefore, it is advisable to present it as a combination of manufacturing, financial, managerial, marketing, environmental and socio-economic sustainability.

Modern economists consider diversification of production, in particular, in the context of macroeconomic stabilization of the economy, with an emphasis on economic restructuring in order to achieve independence (Bobkov and Evseeva, 2017).

Based on this, diversification can be defined as one of the economic strategies used in manufacturing entrepreneurship to expand the scope of activity of an economic entity by launching new goods or services that are unrelated to its core business but are produced using the internal reserves of the available fixed assets (Makhnushina and Shinkevich, 2014). The main content of this strategy is scientific, technical, organizational and commercial activities aimed at discovering new useful goods and services and putting them into production (Deberdieva, 2014).

Today, the problem of transition to diversification remains acute, since it is still poorly understood in economic theory and in practice. Let us note that the first theoretical insights appeared in the first half of the 20th century, however, to this day there is no clear comprehensive concept that could cater to companies that want, or have to, diversify (Dalby and Smit, 2004: 1). The foundation for the theoretical developments was the practical experience accumulated by companies. However, this experience was ambiguous and could not provide a comprehensive concept of diversification (Telegina, 2008). Thus, the theoretical foundations of diversification still lack uniformity and universality.

In Russia, practical and theoretical experience in this area has not been gained yet. There are only a few examples of diversification, which can hardly be called successful. The available concepts of diversification, developed outside Russia, spark interest but often fail to be useful in local

conditions (Tarnavskiy, 2009).

Consider the main stages of the development of diversification (Baumung, 2012):

The 1960s and the 1970s went down in history as a period of diversification of production and active expansion of companies in Europe and, in particular, in the USA. Also, mergers and acquisitions were rather active. If considered from a theoretical view point, this process was the manifestation of the advantages of large-scale production, i.e. synergistic effect. The synergistic effect is an improvement of efficiency arising from integration, merger and acquisition of elements into a coherent whole due to the systemic effect of emergence. The concept of synergy was introduced by Igor Ansoff in order to identify the strategic advantages that arise from the merger of two or more companies into one large enterprise and are aimed at reducing the long-term average production costs.

The late 1970s and early the 1980s brought about a general structural crisis. A significant number of large corporations and conglomerates were exposed to negative trends and suffered heavy losses. The policies aimed at integration and large-scale diversification proved to be disastrous, since the redundancy and lack of control of any action entails negative consequences. Accompanied by demolition of established structures and management methods in the companies and deteriorating skill level of management personnel and manufacturing personnel, excessive diversification turned out to be as dangerous as excessive specialization (Kumar et al., 2012). As a result, the policy of mergers and acquisitions was harshly criticized, and the very possibility of developing a scientifically based strategy in this area was called into question.

The criticism of diversification policy gradually mellowed by the end of the 1980s. Major companies with large amounts of capital began to experience difficulties in increasing their market share further on the world stage. They chose to resort to diversification as a method of rational distribution of investments and mitigation of possible risks. Today, survival in conditions of instability, improvement of sustainability efforts and mitigation of risks are the main challenges of entrepreneurship in any country.

In light of the factors affecting the diversification process and the criteria for diversification effectiveness, this paper proposes a method of implementing the diversification.

3. Results and Discussion

In modern market conditions, any business entity seeks to strengthen its position in the market and adapt to the constantly changing market envi-

ronment. Specialized companies diversify, turning themselves into multi-sector conglomerates, which constituent units are not interconnected functionally.

Lacking experience and knowledge on diversification options, many companies immediately resort to this strategy, instead of studying it in detail. Such poorly planned transition attempts contribute nothing to the development of the company, leading to negative consequences. Therefore, it is necessary to have reliable information in the policy.

Diversification expands the range of manufactured products or provided services and, as a result, curtails the company's dependence on the life cycle of a certain product. This, in turn, increases the efficiency of the business entity and provides a more sustainable growth.

Presently, there are no sufficient grounds to assert that there is a systematic link between the diversification strategy and the efficiency of the company. However, if the transition to diversification is approached reasonably, this may be a prerequisite for improving the efficiency of some units. For example, if costs within an industry are inherently fixed, then they can be broken down into different areas with large sales and hence the unit costs can be reduced.

An important condition for increasing efficiency in diversification is the availability of promising competences that are of strategic interest (Chagarbiyev, 2018). In the production with the possibility of wide use of key competencies, diversification of the company's activities opens up new opportunities in the R&D field (Regnér and Zander, 2011). Consequently, the expansion of the company can create a critical mass of resources, improving the competitiveness of the company.

One of the advantages of a diversified company is the possibility of joint achievement of common goals. The result of such consolidated effort arises from synergistic effect, i.e. the cumulative effort is greater than the sum of the individual efforts. Thus, the majority of large companies increase the profitability of their newly acquired enterprises by improving their management systems and financial control, as well as by reorganizing these enterprises into specialized divisions. In turn, this gives a positive result, consisting in the sharing of resources and experience. The likelihood of achieving this result is higher if the divisions operate in related industries.

One of the fundamental criteria for diversification is the costs necessary for transition, which sometimes requires additional sources of funding. The company must accurately calculate the amount of profit that it plans to receive if the diversification strategy is implemented (Akhmetshin et al.,

2018a). Thus, it is possible to compare the possible profit with the costs associated with the new production. Investing into any business project is always a risky undertaking; therefore, to attract investment, it is necessary to develop a financial model of the project (Harper and Viguerie, 2002).
The system of investment efficiency indicators incorporates the international experience that each participant in the investment process needs, especially if they are for novices (Telegina, 2008). Investment should obviously be made in those projects that can give the maximum effect.
The effectiveness of diversification involved making optimal decisions that help identify factors that have a negative impact on this process, with the aim of eliminating them or adapting to them. Such factors are usually categorized into external and internal. The internal environment of the company is its 'organism', while the external environment is the conditions for the company operations, regardless of the nature of its activities. The scientific literature describes various sets of factors of the internal environment and the business (external) environment, which affect the functioning and further development of the business entity in many ways. Not only the analysis of marketing opportunities, but also the analysis of environment can be foundation for planning and implementing a diversification strategy. The most common tool of analyzing the external environment is SWOT-analysis, which identifies the strengths and weaknesses of the company, as well as the threats and opportunities it may face. After SWOT-analysis, the Ansoff matrix is compiled to strategically determine the positioning goods on the market. It helps systematize the available information about the market and the company's products, rationally choose the direction of business development and take into account the resource potential of the economic entity (Akhmetshin et al., 2018b).
In today's market conditions most companies adhere to traditional forms of organizational change, which focus only on the internal environment, often remaining blind to the impact of external market factors. As a result, the company's potential gets inefficiently distributed over the divisions, whose activities are to some extent decentralized, and this creates additional costs in implementing the diversification strategy.
Companies often face difficulties with solving problems in due time. In this regard, it is necessary to develop a system of measures to improve the management of diversification and to harmonize the diversification goals and the economic interests of the company (Nemchenko et al., 2014; Buckley, 2018). In addition, it is also necessary to identify the main criteria of the commercial effectiveness of diversification.

Modern entrepreneurship needs structure diversification, factoring in and grouping the most urgent problems. Such problems should be solved comprehensively through system analysis and diagnostics, with subsequent implementation in the process of company operation.

Therefore, taking into account the criteria of commercial efficiency of diversification, we propose the following procedure for implementing a diversification strategy:

At the first stage, the company identifies the important technical problems that are associated with the modernization of production and reflect the strategic goals of diversification. These problems should be identified by analyzing the development directions of the company.

At the second stage, the company plans key activities that are aimed at achieving the strategic goals of the company; the key activities should be in line with the prioritized directions of diversification.

At the third stage, the company structures the actions aimed at the implementation of the diversification strategy; as a result, the company develops a set of organizational and technical measures, including the main activities for the transition to diversification.

The main criteria for the economic efficiency of diversification are such indicators as obtaining additional financial results in the form of revenue from the sale of products; profits derived from the activities of the business entity, taking into account the time costs associated with the development and implementation of the diversification strategy.

Thus, taking into account the above criteria for assessing the economic efficiency of the diversification strategy, one can determine how acceptable are the decisions taken on the development and implementation of the diversification strategy for the operating company.

Creating a pool of development directions that the prioritized directions of diversification can be chosen from, is one of the criteria for the effectiveness of diversification of the company. It contributes to the rational allocation of available financial resources in the process of its implementation.

Considering the analyzed factors affecting the diversification process, as well as the criteria for its effectiveness, we propose the following methodology for diversification: at the first stage, it is necessary to determine the priority directions of the enterprise's development; at the second stage, the diversification process is structured, taking into account the characteristic features of the economic entity; at the third stage, the directions of using innovations are determined as the main form of using priority directions of ongoing diversification; at the final stage, it is necessary to create a

mechanism for implementing the diversification strategy in the enterprise. In light of the above factors affecting the diversification process and the criteria for diversification effectiveness, this paper proposes a method of implementing the diversification: first, it is necessary to determine the prioritized directions of company development; second, the diversification process is structured, taking into account the characteristic features of the economic entity; third, the company chooses the directions of innovation as the main form of the prioritized directions of ongoing diversification; fourth, it is necessary to create a mechanism for implementing the diversification strategy in the company (Kononenko, 2015).

At present, sustainable (long-term) development is of particular importance for economic entities operating in conditions of tough competition and dynamic environment. The sustainable development can be achieved by competent strategic management, efficiency of business processes, increase in the capital of the company, diversification of production and other activities (Kadachiev, 2013; Shabaltun and Lemanova, 2016). These factors have a significant impact on the formation of the market capitalization of the company.

PJSC LUKOIL (hereinafter Lukoil) is one of the world largest vertically diversified oil and gas companies. The main activities are exploration, production, processing and selling of petroleum and petroleum products. Lukoil's business model rests on the principle of effective vertical integration to ensure its sustainable development through diversification of risks (PJSC LUKOIL, 2012; 2018).

Lukoil's development strategy is based on diversification, which contributes to strengthening Lukoil's competitive advantages in the international market (Kadachiev, 2013). In turn, this plays an important role in the development of the oil industry and, therefore, the national economy. Lukoil cultivates new business segments, which makes it possible to use its resources with maximum efficiency. The company pursues several directions, such as diversification of energy resources, including the development of alternative energy sources; modernization of fixed assets in order to increase the beneficial use of raw materials and the production of high-quality products; and access to foreign markets.

Despite this, Lukoil focuses on the exploration and production of traditional hydrocarbon energy sources oil and gas, i.e. adheres to the strategy of vertical diversification.

A diversified portfolio of energy sources, including oil, gas, power generation and renewable energy, ensures the sustainable development of the

company, the reliability of energy supply and the contribution to the sustainable development of society.

Market capitalization can be taken as an integral indicator of Lukoil's sustainable development. However, let us first name the factors (indicators) that determine it. The following financial and economic coefficients (indicators) affect the amount of capitalization:

current liquidity that is calculated as the ratio of current assets to short-term liabilities, shows the company's ability to repay current (short-term) liabilities with current assets only, i.e. characterizes its solvency;

autonomy ratio (financial independence) that is calculated as the ratio of equity to the value of all assets and shows how independent the company is from its creditors;

flexibility (current assets to equity) ratio that shows the company's ability to maintain the level of current assets at the expense of equity;

asset turnover ratio that shows efficiency of use of all company's assets and is calculated as the ratio of revenue to the average annual value of assets;

asset profitability ratio that characterizes the return on the use of all assets and is calculated as the ratio of net profit to the value of all assets;

dividend yield that is calculated as the ratio of dividend per share (per year) to the price of share and indicates the investment attractiveness of the company;

coefficient of validity of fixed assets is calculated as the ratio of the residual value of fixed assets to their total initial value (Ermolovich, 2014).

The figures for calculating the above coefficients were taken from Lukoil's consolidated financial statements for 2008–2017; see Table 1. The calculated coefficients are given in Table 2.

The calculations show that the average current ratio for the studied period is 1.73; the optimal value being 1.5–2.5. This suggests that the company is solvent and can easily repay its short-term liabilities from the working capital.

The average autonomy ratio is 0.7, which means that the majority of the company's assets are formed from its own funds (70%), while the rest (30%) is covered by borrowed funds. Thus, the company's dependence on creditors is small, which increases its investment attractiveness.

The average coefficient of validity of fixed assets is 0.93, which indicates a good technical condition of fixed assets; therefore, the company does not require significant costs for repair and renovation.

The average flexibility coefficient is 0.34; the optimal value being 0.2–0.5. This suggests that the company is able maintain the required level of current assest at its own expense.
The average turnover ratio for the analyzed period is 1.33, which means that for every ruble of used assets there is 1.33 rubles of revenue.
The average asset profitability ratio is 0.12, i.e. for each 100 rubles invested in the assets of the company, there are 12 rubles of net profit.
The above ratios fall into the optimal range, which positively affects Lukoil's capitalization (Fig. 1).
Fig. 1 shows that in 2009 Lukoil's capitalization increased by 76%, or by 623 billion rubles, compared to the previous year. This leap happened due to the commissioning of two photovoltaic power plants, which convert solar energy to electricity, in Russia and Serbia in 2009 (conglomerate diversification) (Akhmetshin et al., 2018a).
In 2011, American multinational energy corporation ConocoPhillips, which had owned a 20.8% share in Lukoil's share capital, withdrew from the company, having sold all its shares. This adversely affected the overall market value of the company, and it fell by 33 billion rubles. However, in 2012, Lukoil bought out 12.6% of its shares, paying 5.82 billion USD for them. As a result, the total value of its shares increased by 253 billion rubles, or by 17.5%.
In 2014, Lukoil took another step to conglomerate diversification by launching commercial production of diamonds in Arkhangelsk Region. The investments in this project amounted to about 1.2 billion USD. The project revenue was about 190 million USD a year. This decision strengthened the company's position in the stock market; as a result of the increase in non-core assets of the company, its market value increased by 103 billion rubles.
In 2016, Lukoil's market capitalization increased significantly by 938 billion rubles, or 47%. This uptrend was due to its acquisition of about 250 gas stations in Belgium, Luxembourg and the Netherlands (vertical geographic diversification).
The period from 2011 to 2016 produced a positive trend; however, in 2017, the level of capitalization decreased by 97 billion rubles because Lukoil sold the Arkhangelsk-based diamond mining subsidiary and European diamond trader Grib Diamonds.
When analyzing the interrelation of sustainable development indicators, it is necessary to apply the actual data of Lukoil and the factors of external environmental for the period 2008–2017, which, in our opinion, had a sig-

nificant impact on the efficient operation and sustainable development of this company (Table 4).

Let the capitalization (market value) be the performance criterion (y), which characterizes the company's sustainable development, the company's; then the factors that determine criterion y are the average annual USD rate (X1), inflation (X2), dividend yield (X3) and profit (X4).

Based on the data presented in Table 4, we perform the following calculations (Soroka, 2012):

find the parameters of the multiple linear regression equation using the ordinary least squares (OLS) method and build a multiple linear regression equation;

find partial elasticity coefficients;

find standardized regression elasticities;

find paired and inter-factor correlation coefficients;

estimate the resulting equation based on the determination coefficient and Fisher's F-test;

estimate the statistical significance of the multiple correlation coefficient using Student's t-test;

estimate the resulting model based on the average approximation error.

Now let us implement the above algorithm:

Step 1. To find the parameters of the multiple regression equation, we use the OLS method that consists in minimizing the sum of squares of deviations of the performance criterion (y) values from the theoretically calculated values ($\hat{y}$):

$$\sum (y - \hat{y}_x)^2 \to min(1)$$

Using this method, we build a system of normal equations; the solution of the system of normal equations makes it possible to obtain estimates of the regression parameters. Consider a linear model of multiple regression:

$$y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + \varepsilon, (2)$$

where y is the dependent variable; a, b_i are the regression parameters (coefficients); x_i are the independent variables; and ε is the deviation estimate.

Next, we find the partial derivatives of the first order:

$$\{\frac{\partial S}{\partial a} = -2\sum_{\square}^{\square}\square(y - a - b_1x_1 - b_2x_2 - \cdots - b_mx_m) = 0\frac{\partial S}{\partial b_1}$$

$$= -2\sum_{\square}^{\square}\square x_1(y - a - b_1x_1 - b_2x_2 - \cdots - b_mx_m)$$

$$= 0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\frac{\partial S}{\partial b_m}$$

$$= -2\sum_{\square}^{\square}\square x_m(y - a - b_1x_1 - b_2x_2 - \cdots - b_mx_m) = 0(3)$$

Using mathematical devices, we obtain the following system of linear normal equations to find the parameters of a linear multiple regression equation (Prokazin and Dolgopolova, 2019):

$$\{na + b_1\sum_{\square}^{\square}\square x_1 + b_2\sum_{\square}^{\square}\square x_2 + \cdots + b_m\sum_{\square}^{\square}\square x_m$$

$$= \sum_{\square}^{\square}\square ya\sum_{\square}^{\square}\square x_1 + b_1\sum_{\square}^{\square}\square x_1^2 + b_2\sum_{\square}^{\square}\square x_1x_2 + \cdots + b_m\sum_{\square}^{\square}\square x_1x_m$$

$$= \sum_{\square}^{\square}\square yx_1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots a\sum_{\square}^{\square}\square x_m$$

$$+ b_1\sum_{\square}^{\square}\square x_1x_m + b_2\sum_{\square}^{\square}\square x_1x_m + \cdots + b_m\sum_{\square}^{\square}\square x_m^2 = \sum_{\square}^{\square}\square yx_m(4)$$

Since this is a four-factor model, the system takes the following form:

$$\{na + b_1 \sum x_1 + b_2 \sum x_2 + b_3 \sum x_3 + b_4 \sum x_4$$

$$= \sum ya \sum x_1 + b_1 \sum x_1^2 + b_2 \sum x_1 x_2 + b_3 \sum x_1 x_3 + b_4 \sum x_1 x_4$$

$$= \sum y x_1 a \sum x_2 + b_1 \sum x_1 x_2 + b_2 \sum x_2^2 + b_3 \sum x_2 x_3$$

$$+ b_4 \sum x_2 x_4$$

$$= \sum y x_2 a \sum x_3 + b_1 \sum x_1 x_3 + b_2 \sum x_2 x_3 + b_3 \sum x_3^2$$

$$+ b_4 \sum x_3 x_4$$

$$= \sum y x_3 a \sum x_4 + b_1 \sum x_1 x_4 + b_2 \sum x_2 x_4 + b_3 \sum x_3 x_4$$

$$+ b_4 \sum x_4^2 = \sum y x_4 (5)$$

The calculated values of the system elements are given in Table 5.

With the substituted values, the system will take the following form:

$$\{10a + 403{,}42b_1 + 88{,}9b_2 + 56{,}14b_3 + 3{,}82b_4$$
$$= 18{,}28403{,}2a + 18381{,}63b_1 + 3502{,}2b_2 + 2410{,}02b_3 + 160{,}64b_4$$
$$= 815{,}888{,}9a + 3502{,}2b_1 + 870{,}29b_2 + 492{,}62b_3 + 32{,}97b_4$$
$$= 153{,}5956{,}14a + 2410{,}02b_1 + 492{,}62b_2 + 334{,}78b_3 + 21{,}77b_4$$
$$= 108{,}323{,}82a + 160{,}64b_1 + 32{,}97b_2 + 21{,}77b_3 + 1{,}51b_4 = 7{,}23 \quad (6)$$

Having solving this system of linear equations by the Gauss method, we obtain the following values of the parameters of linear multiple regression equation: a=1.92; b_1=0.04; b_2=-0.096; b_3=-0.005; b_4=-2.19.
Thus, we obtain the following multiple regression equation:
y=1,92+0,04x_1-0,096x_2-0,005x_3-2,19x_4 (7)
Therefore:

if the USD rate increases by one percentage point, the growth of Lukoil's capitalization is 40 billion rubles;

if the inflation decreases by 1%, Lukoil's capitalization increases by 96 billion rubles;

if the dividend yield decreases by one point, Lukoil's capitalization increases by 5 billion rubles;

if the profit decreases by 1 trillion rubles, Lukoil's capitalization increases by 2.19 trillion rubles.

Step 2. We calculate the partial elasticity coefficients . The elasticity coefficients show by how many percent the result will change on average when the corresponding factor changes by 1% with constant values of all other factors.
The partial elasticity coefficients are calculated by the formula:

$$\ni_{x_i} = b_i \cdot \frac{x_i}{\underline{y}}, \quad (8)$$

The positive/negative value of the elasticity coefficient corresponds to the value of the regression coefficient for a given factor in the regression equation and reflects the direct or inverse relationship between them and the result.

where $э_{x_i}$ is the partial elasticity coefficient; b_i is the parameter of linear multiple regression equation (regression coefficient); and $\underline{x_i}, \underline{y}$ are the mean values of the factor and performance criteria.

Thus, we obtain:

$$э_{x_1} = b_1 \cdot \frac{x_1}{\underline{y}} = 0{,}04 \cdot \frac{40{,}34}{1{,}83} = 0{,}88;$$

$$э_{x_2} = b_2 \cdot \frac{x_2}{\underline{y}} = -0{,}096 \cdot \frac{8{,}89}{1{,}83} = -0{,}47;$$

$$э_{x_3} = b_3 \cdot \frac{x_3}{\underline{y}} = -0{,}005 \cdot \frac{95{,}614}{1{,}83} = -0{,}015;$$

$$э_{x_4} = b_4 \cdot \frac{x_4}{\underline{y}} = -2{,}19 \cdot \frac{0{,}38}{1{,}83} = -0{,}46.$$

The USD rate has a greater impact on Lukoil's market value, i.e. if the USD rate grows by 1 point, the average capitalization increases by 0.88%. Since the elasticity coefficient is less than 1, the effect on the performance criterion is insignificant.

Step 3. We calculate the standardized regression elasticities by the formula:

$$\beta_i = b_i \cdot \frac{\sigma_{x_i}}{\sigma_y}, \quad (9)$$

where β_i is the standardized regression elasticity coefficient; b_i is the parameter of the linear multiple regression equation; and are σ_{x_i}, σ_y the variances of x and y.

The variance is calculated by the formula:

$$\sigma_{x_i} = \sqrt{\underline{x_i^2} -$$

Substituting the corresponding values in this formula, we obtain variances x_i and y:

$$\sigma_{x_1} = \sqrt{\underline{x_1^2} -$$

$$\sigma_{x_2} = \sqrt{\underline{x_2^2} -$$

$$\sigma_{x_3} = \sqrt{\underline{x_3^2} -$$

$$\sigma_{x_4} = \sqrt{\underline{x_4^2} -$$

$$\sigma_y = \sqrt{\underline{y^2} -$$

Next, we calculate the standardized regression elasticities:

$$\beta_1 = b_1 \cdot \frac{\sigma_{x_1}}{\sigma_y} = 0{,}04 \cdot \frac{14{,}52}{0{,}61} = 0{,}95$$

$$\beta_2 = b_2 \cdot \frac{\sigma_{x_2}}{\sigma_y} = -0{,}096 \cdot \frac{2{,}83}{0{,}61} = -0{,}44$$

$$\beta_3 = b_3 \cdot \frac{\sigma_{x_3}}{\sigma_y} = -0{,}005 \cdot \frac{1{,}4}{0{,}61} = -0{,}011$$

$$\beta_4 = b_4 \cdot \frac{\sigma_{x_4}}{\sigma_y} = -2{,}19 \cdot \frac{0{,}07}{0{,}61} = -0{,}25$$

The standardized elasticities show that:

- if the USD rate changes by 1 point with the other factors remaining unchanged, then the capitalization will change by 950 billion rubles on average;
- if the inflation rate changes by 1% with the other factors remaining unchanged, then the capitalization will change by 440 billion rubles on average;
- if the dividend yield changes by 1 point with the other factors remaining unchanged, then the capitalization will change by 11 billion rubles on average;
- if the profit changes by 1 billion rubles with the other factors remaining unchanged, the capitalization will change by 250 billion rubles on average.

Step 4. We find paired and inter-factor correlation coefficients. The paired correlation coefficient is calculated by the formula (Prokazin and Dolgopolova, 2019):

$$r_{yx_i} = \frac{\overline{x_i y} - \overline{x_i} \cdot \overline{y}}{\sigma_{x_i} \cdot \sigma_y} \quad (11)$$

Using this formula, we obtain the following values of the paired correlation coefficients:

$$r_{yx_1} = \frac{\overline{x_1 y} - \overline{x_1} \cdot \overline{y}}{\sigma_{x_1} \cdot \sigma_y} = \frac{81{,}58 - (40{,}34 * 1{,}83)}{14{,}515 * 0{,}61} = 0{,}89$$

$$r_{yx_2} = \frac{\overline{x_2 y} - \overline{x_2} \cdot \overline{y}}{\sigma_{x_2} \cdot \sigma_y} = \frac{15{,}36 - (8{,}89 * 1{,}83)}{2{,}83 * 0{,}61} = -0{,}52$$

$$r_{yx_3} = \frac{\overline{x_3 y} - \overline{x_3} \cdot \overline{y}}{\sigma_{x_3} \cdot \sigma_y} = \frac{10{,}83 - (5{,}614 * 1{,}83)}{1{,}4 * {,}61} = 0{,}67$$

$$r_{yx_4} = \frac{\overline{x_4 y} - \overline{x_4} \cdot \overline{y}}{\sigma_{x_4} \cdot \sigma_y} = \frac{0{,}72 * (0{,}38 * 1{,}83)}{0{,}07 * 0{,}61} = 0{,}58$$

The strongest correlation is observed between the capitalization and the USD rate. Their correlation coefficient is equal to 0.89, which indicates a strong positive relation between the variables. Hence if the USD rate changes by 1 point with the other factors remaining unchanged, then the capitalization will change by 890 billion rubles. There is a good negative

relation between the capitalization and the inflation. If the inflation rate decreases by 1%, the capitalization increases by 52 billion rubles. The correlation coefficient between the capitalization and the dividend yield is 0.67, which suggests that there is a good positive relation between these indicators. If the dividend yield increases by 1 point, the capitalization increases by 670 billion rubles. There is also a good positive relation between the capitalization and the profit. If the profit increases by 1 billion rubles, the capitalization increases by 580 billion rubles.

Similarly, we find the inter-factor correlation coefficient (Prokazin and Dolgopolova, 2019):

$$r_{x_i x_j} = \frac{\overline{x_i x_j} - \overline{x_i} \cdot \overline{x_j}}{\sigma_{x_i} \cdot \sigma_{x_j}} \quad (12)$$

Consequently, we obtain the following values of inter-factor coefficients:

$$r_{x_1 x_2} = \frac{\overline{x_1 x_2} - \overline{x_1} \cdot \overline{x_2}}{\sigma_{x_1} \cdot \sigma_{x_2}} = \frac{350{,}22 - (40{,}34 * 8{,}89)}{14{,}52 * 2{,}83} = -0{,}21$$

$$r_{x_1 x_3} = \frac{\overline{x_1 x_3} - \overline{x_1} \cdot \overline{x_3}}{\sigma_{x_1} \cdot \sigma_{x_3}} = \frac{241 - (40{,}34 * 5{,}614)}{14{,}52 * 1{,}4} = 0{,}71$$

$$r_{x_1 x_4} = \frac{\overline{x_1 x_4} - \overline{x_1} \cdot \overline{x_4}}{\sigma_{x_1} \cdot \sigma_{x_4}} = \frac{16{,}06 - (40{,}34 * 0{,}38)}{14{,}52 * 0{,}07} = 0{,}65$$

$$r_{x_2 x_3} = \frac{\overline{x_2 x_3} - \overline{x_2} \cdot \overline{x_3}}{\sigma_{x_2} \cdot \sigma_{x_3}} = \frac{49{,}26 - (8{,}89 * 5{,}614)}{2{,}83 * 1{,}4} = -0{,}16$$

$$r_{x_2 x_4} = \frac{\overline{x_2 x_4} - \overline{x_2} \cdot \overline{x_4}}{\sigma_{x_2} \cdot \sigma_{x_4}} = \frac{3{,}3 - (8{,}83 * 0{,}38)}{2{,}83 * 0{,}07} = -0{,}5$$

$$r_{x_3 x_4} = \frac{\overline{x_3 x_4} - \overline{x_3} \cdot \overline{x_4}}{\sigma_{x_3} \cdot \sigma_{x_4}} = \frac{2{,}18 - (5{,}614 * 0{,}38)}{1{,}4 * 0{,}07} = 0{,}34$$

Step 5. We estimate the resulting equation based on the determination coefficient and Fisher's F-test.

As can be seen, the multiple correlation coefficient is $R = 0{,}96$; therefore, the determination coefficient is $R^2 = 0{,}93$. Thus, the obtained linear model explains 93% of variations of the performance criterion y. This indicates a good selection of factors, and 7% of variations of the performance criterion y can be explained by other factors unaccounted for in the model.

Next, we test the significance of the multiple regression equation using F-distribution. The formula for Fisher's F-test is as follows:

$$F = \frac{R^2}{1 - R^2} \cdot \frac{n - m - 1}{m}, \quad (13)$$

where R^2 is the determination coefficient; n is the number of observations; m is the number of independent variables; and $-m-1$ is the number of degrees of freedom.

Substituting the corresponding values in this formula, we obtain:

$$F = \frac{0{,}93}{1-0{,}93} \cdot \frac{10-4-1}{4} = 13{,}29 * 1{,}25 = 16{,}61$$

The tabulated value of Fisher's F-test is $F_т = 5.19$at significance level $\alpha = 0.05$ and degrees of freedom 5;4 $(n-m-1)$. If $H_1 \rightarrow (b \neq 0)$, $H_0 \rightarrow (b = 0)$, then $F > F_т \rightarrow H_1$, $F < F_т \rightarrow H_0$. As can be seen, $F > F_т$, i.e. $16.61 > 5.19$. This indicates that the regression equation is statistically significant, i.e. hypothesis H_1 on the significance of the regression equation is accepted.

Step 6. We estimate the statistical significance of the multiple correlation coefficient using Student's t-test. The formula is as follows:

$$t = \frac{R \cdot \sqrt{n-2}}{\sqrt{1-R^2}}, (14)$$

where R is the multiple correlation coefficient; $n-2$ is the number of degrees of freedom; and R^2 is the determination coefficient.

Next, we obtain:

$$t = \frac{0{,}96 \cdot \sqrt{10-2}}{\sqrt{1-0{,}93}} = \frac{0{,}96 \cdot \sqrt{8}}{\sqrt{0{,}07}} = \frac{2{,}72}{0{,}265} = 10{,}26$$

The tabulated value of Student's t-test is $t_т = 2.31$ at significance level of $p = 0.05$ and a given number of degrees of freedom 8 $(n-2)$. If $t > t_т \rightarrow H_1$, then $t < t_т \rightarrow H_0$. Since $t > t_т$, i.e. $10.26 > 2.31$, therefore, it can be concluded that the multiple correlation coefficient of is statistically significant, i.e. hypothesis H_1 on the significance of the regression equation is accepted.

Step 7. We estimate the resulting model based on the average approximation error. The average approximation error is calculated by the formula:

$$\underline{A} = \frac{\sum_{\square}^{\square} |y_i - \hat{y}_i| / y_i}{n} \cdot 100\% (15)$$

Substituting the values of the factor variables into the regression equation, we obtain the calculated (modeled) values of the performance criterion $\hat{y}_i$; see Table 7.

The approximation error is $\underline{A} = 9.47$. The allowable approximation error should not exceed 10%.

Following the OLS method, let us test the model for multicollinearity. Multicollinearity is a violation of one of the basic conditions that form the basis of the linear multiple regression model. It is a linear dependence between the factor variables included in the model. If the correlation coefficient between the independent variables is r_(x_i x_j)≥0,7, then the model has multicollinearity.

The main reasons why it is undesirable to include multicollinear factors in the model are the following:

the hypothesis of the insignificance of the multiple regression coefficients H_0 can be confirmed; however, the regression model itself, when tested using Fisher's F-test, happens to be significant, and this indicates an overestimation of the value of the multiple correlation coefficient;

the obtained estimates of the coefficients in the multiple regression model may be significantly overestimated or have incorrect positive or negative value;

adding or excluding of one or two observations from the baseline data has a significant impact on the estimated coefficients of the model;

the multicollinear factors included in the multiple regression model make it economically worthless.

To test Model 7 for multicollinearity, we construct a table of paired correlation coefficients.

As can be seen from Table 8, factors x_1 and x_3 overlap (r⎪x_1 x_3=0.71), i.e. the model has multicollinearity. Therefore, it is advisable to include factor x_1 in the analysis since the correlation of factor x_1 with the performance criterion y is stronger than the correlation of factor x_3, i.e. r_(yx_1)=0.89>r_(yx_3)=0.67. It is necessary to eliminate factor x_3 and replace the table values of factor x_3with those of factor x_4.

Eliminating one factor (dividend yield), we obtain a new three-factor correlation-regression model:

$$y=a+b_1 x_1+b_2 x_2+b_3 x_3+\varepsilon \quad (16)$$

To find the parameters of the regression model (regression coefficients), we fill a table with the baseline data (Table 9).

Using the same mathematical tools as for the four-factor model, we obtain the following values of the regression equation parameters: a=1,89; b_1=0,04; b_2=-0,096; b_3=-2,16. Consequently, the multiple regression equation takes the following form:

$$y=1,89+0,04x_1-0,096x_2-2,16x_3 \quad (17)$$

By calculating the paired correlation coefficients of the modified model, we obtain the values given in Table 10.

Based on the obtained values (Table 10), it can be stated that there is no multicollinearity in the model. A strong positive relation is observed between the capitalization and the USD rate, the correlation coefficient being 0.89.

Let us evaluate Equation 17 on the basis of the determination coefficient and Fisher's F-test. To do this, we calculate the linear multiple correlation coefficient in Excel (Data Analysis / Regression).

The multiple correlation coefficient is R=0.96, therefore, the determination coefficient is R^2=0.93. Thus, the obtained linear model explains 93% of variations of the performance criterion y. This indicates a good selection of factors, and 7% of variations of the performance criterion y can be explained by other factors unaccounted for in the model.

Next, we test the significance of the multiple regression equation using F-distribution. Using Equation 13, we obtain:

$$F=0,93/(1-0,93)\cdot(10-3-1)/3=13,29*2=26,58$$

The tabulated value of Fisher's F-test is $F_т=5.19$at significance level $\alpha=0.05$ and degrees of freedom 6;3 (n-m-1). Therefore, $F>F_т$, i.e. 16.61>5.19. This indicates that the regression equation is statistically significant, i.e. hypothesis H_1 on the significance of the regression equation is accepted.

Next, we estimate the statistical significance of the multiple correlation coefficient using Student's t-test (Equation 14):

$t=(0,96\cdot\sqrt{(10-2)})/\sqrt{(1-0,93)}=(0,96\cdot\sqrt{8})/\sqrt{0,07}=2,72/0,265=10,26$

The tabulated value of Student's t-test is t_T=2.31 at significance level of p=0.05 and a given number of degrees of freedom 8 (n-2). Since t>t_T, i.e. 10.26>2.31, therefore, it can be concluded that the multiple correlation coefficient of is statistically significant, i.e. hypothesis H_1 on the significance of the regression equation is accepted.

Finally, will evaluate the resulting Model 17 based on the average approximation error (Table 12).

The permissible approximation error should not exceed 10%, and in our case it is A=9.59.

4. Conclusion

Capitalization can be influenced by many factors of both internal and external environments. The correlation-regression analysis can be used to identify the impact of certain factors on the performance criterion, i.e. on market capitalization.

Recently, multiple regression has become widely used in economic research. It can be applied to solving problems related to regulating supply and demand, enterprise profitability, securities profitability, production costs, determining macroeconomic indicators and issues. Today, multiple regression is the predominantly used method in econometrics. The main task of multiple regression is to create a model of many factors and to estimate the impact of each factor separately and collectively on the performance criterion.

Fig. 2 shows the deviations of the actual value of capitalization from the modeled ones. The multiple correlation coefficient is R=0.96, which points to a close positive relation between the dependent variable and the factor variables in the aggregate. There are practically no deviations between the actual and the modeled values of the performance criterion (or they are insignificant). The determination coefficient is R_2=0.93, and the average approximation error is 9.59%. This is the result of a qualitative selection of factors (independent variables) of the regression model that fairly accurately describe trends in the performance criterion, i.e. 93% variation in capitalization occurs due to the variation of the factor variables, and the remaining 7% can be explained by factors unaccounted for in the model.

Since the average approximation error does not exceed the permissible level, the resulting model is adequate and can be used in further studies.

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References

AKHMETSHIN, E. M., KOPYLOV, S. I., LOBOVA, S. V., PANCHENKO, N. B., and KOSTYLEVA, G. 2018a. Specifics of the fuel and energy complex regulation: seeking new opportunities for Russian and international aspects. International Journal of Energy Economics and Policy. Vol. 8, Nº 4: 169–177.

AKHMETSHIN, E. M., VASILEV, V. L., MIRONOV, D. S., ZATSARINNAYA, E. I., ROMANOVA, M. V., and YUMASHEV, A. V. 2018b. Internal control system in enterprise management: Analysis and interaction matrices. European Research Studies Journal. Vol. 21. Nº 2: 728–740.

AZIEVA, R. H., CHAZHAYEV, M. I., CHAPLAYEV, H. G., GAPA-

YEVA, S. U., and MAZHIYEV, K.H. 2019. Innovative breakthrough technology blockchain in the oil and gas industry. European Proceedings of Social and Behavioural Sciences. Nº LVIII: 142–149.
BAUMUNG, E. V. 2012. Etapy razvitiya diversifikatsii proizvodstva [Stages of development of production diversification]. Molodoy Uchyony. Nº 3: 144–150.
BOBKOV, K. A. and EVSEEVA, A. A. 2017. Diversifikatsiya deyatelnosti predpriyatiya [Diversification of enterprise activity]. E-Koncept. Nº 39: 3566–3570.
BUCKLEY, P. J. 2018. Internalisation theory and outward direct investment by emerging market multinationals. Management International Review. Nº 58: 195–224.
CHAGARBIYEV, S. N. (2018). Diversifikatsiya kak strategiya ustoychivogo razvitiya predpriyatiya [Diversification as a strategy for sustainable enterprise development]. Molodoy Uchyony. Nº 10: 108–111.
DALBY, M. and SMIT, T. S. 2004. A new look at diversification. McKinsey Quarterly.
DEBERDIEVA, E. M. 2014. Podkhody k obosnovaniyu strategii neftegazovykh kompaniy [Approaches to the substantiation of strategy of oil and gas companies]. Neft, Gas i Biznes. Nº 6: 10–14.
Diversifikatsiya biznesa: ponyatiye, osnovy, etapy. Razrabotka biznes-plana diversifikatsii deyatel'nosti predpriyatiya [Business diversification: concept, basics, stages. Development of a business plan for the diversification of company]. n.d. Available at: https://businessman.ru/diversifikatsiya-biznesa-ponyatie-osnovyi-etapyi-razrabotka-biznes-plana-diversifikatsii-deyatelnosti-predpriyatiya.html. Accessed on 15 April 2019.
ERMOLOVICH, L. L. 2014. Analiz finansovo-khozyaystvennoy deyatelnosti predpriyatiya [Analysis of financial and economic activity of an enterprise]. Belarus State Economic University. Minsk (Belarus).
HAMILTON, L. C. 2009. Statistics with STATA: Updated for Version 10. Brooks/Cole, Cengage Learning.
HARPER, N. W. C. and VIGUERIE, S. P. 2002. Are you too focused? The McKinsey Quarterly. MidSummer: 29–38.
KADACHIEV, M. Kh. 2013. Konkurentosposobnost TNK: Lukoyl i Rosneft [Competitiveness of TNC: Lukoil and Rosneft]. Modern High Technologies. Vol. 10. Nº 1: 15–16.
KONONENKO, T. E. 2015. Metodologicheskiye aspekty diversifikatsii proizvodstva. Osobennosti diversifikatsii v stroitelstve [Methodologi-

cal aspects of production diversification: Features of diversification in construction]. Sovremennyye tendentsii razvitiya nauki i tekhnologiy. Nº 4–5: 77–80.
KUMAR, V., GAUR, A. S., and PATTNAIK, C. 2012. Product diversification and international expansion of business groups. Management International Review. Vol. 52. Nº 2: 175–192.
MAKHNUSHINA, V. N. and SHINKEVICH, A. N. 2014. Evolyutsiya ponyatiya "diversifikatsiya" v ekonomicheskoy mysli [Evolution of "diversification" notion in economic thought]. Proceedings of Voronezh State University. Series: Economics and Management. Nº 3: 5–9.
MAU, V. 2016. Between crises and sanctions: economic policy of the Russian Federation. Post Soviet Affairs. Vol. 32. Nº 4: 350–377.
NEMCHENKO, G., DONETSKAYA, S., and DYAKONOV, K. 2014. Diversifikatsiya proizvodstva: tseli i napravleniya deyatelnosti [Diversification of production: goals and activities]. Problemy teorii i praktiki upravleniya. Nº 5: 69–80.
NIAZYAN, V. G. 2015. Teoreticheskiye podkhody k opredeleniyu ustoychivogo razvitiya [Theoretical approaches to definition of sustainable development]. Baikal Research Journal. Vol. 6. Nº 1. Available at: https://doi.org/10.17150/2072-0904.2015.6(1).13
OVSYANNIKOV, S. V. 2017. Metodologiya i metodicheskiy instrumentariy upravleniya ustoychivym razvitiyem promyshlennykh predpriyatiy [Methodology and methodological tools for managing the sustainable development of industrial enterprises]. Extended abstract of D.Sc. Dissertation, Institute of Market Problems of the Russian Academy of Sciences. Moscow (Russia).
PJSC LUKOIL. 2012. 2012–2021 Strategic Development Program. Available at: www.lukoil.ru. Accessed on 15 April 2019.
PJSC LUKOIL. 2018. Official website. Available at: www.lukoil.ru. Accessed on 15 April 2019.
PROKAZIN, A. A. and DOLGOPOLOVA, A. F. 2019. Elementy teorii korrelyatsii v ekonomicheskikh raschetakh [Elements of the theory of correlation to economic calculations]. Proceedings of the 11th International Student's Scientific Conference "Student's Scientific Forum 2019". May 2019, Science Park of Moscow State University. Moscow (Russia). Available at: http://files.scienceforum.ru/pdf/2019/5c52a7fb04a55.pdf. Accessed on 15 April 2019.
REGNÉR, P. and ZANDER, U. 2011. Knowledge and Strategy Creation in Multinational Companies. Management International Review. Vol. 51.

Nº 6: 821–850.
SHABALTUN, M. I. and LEMANOVA, P. V. 2016. Znachimost strategii diversifikatsii v usloviyakh konkurentsii [Importance of diversification strategy in competitive environment]. Mezhdunarodnyy studencheskiy nauchnyy vestnik. Vol. 4. Nº 4.
SOROKA, Ya. A. 2012. Kontseptsiya razrabotki regressionnoy modeli analiza i prognozirovaniya finansovogo sostoyaniya predpriyatiy promyshlennosti [Concept development of a regression model analysis and forecasting financial condition of the industry]. Upravleniye ekonomicheskimi sistemami. Vol. 11. Nº 47.
TARNAVSKIY, V. 2009. Kitayskiye varianty diversifikatsii neftyanogo importa [China's options for diversifying oil imports]. Uaenergy. 24 November 2009. Available at: http://www.uaenergy.com.ua/c225758200614cc9/0/7c6567bd684ba947c22576780042d8e5. Accessed on 15 April 2019.
TELEGINA, E. A. 2008. Strategiya razvitiya mirovogo neftegazovogo kompleksa: perspektivy diversifikatsii [Development strategy of the world oil and gas complex: Prospects for diversification]. Zapiski Gornogo Instituta. Vol. 179: 232–240.

Fig. 1. Dynamics of market value of PJSC LUKOIL for the period 2008–2017

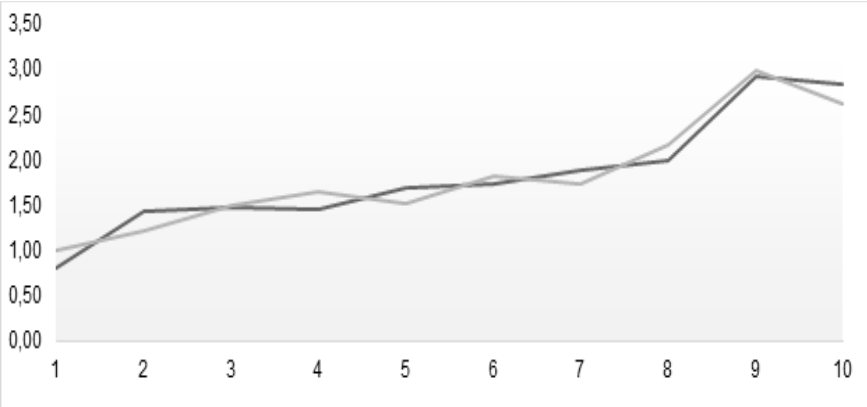

Fig. 2. Deviations of the actual market capitalization of PJSC LUKOIL from the obtained model; darker grey – actual values of performance criterion; lighter grey – modelled values of performance criterion.

Tables

Table 1. Performance of PJSC LUKOIL in 2008–2017 (trillion rubles) (Azieva et al., 2019)

Year	Revenue	Cost of production	Profit	Short-term liabilities	Long-term liabilities	Current assets	Fixed assets	Depreciation and amortization	Equity funds	Borrowed funds	Capital	Intangible assets	Balance-sheet value
2008	2.68	2.34	0.34	0.26	0.26	0.39	1.39	0.07	1.25	0.53	1.78	0.03	1.75
2009	2.58	2.27	0.31	0.31	0.41	0.57	1.95	0.13	1.79	0.72	2.52	0.05	2.46
2010	3.19	2.84	0.35	0.33	0.41	0.63	1.92	0.13	1.81	0.74	2.55	0.04	2.51
2011	3.93	3.54	0.39	0.33	0.37	0.69	1.99	0.13	1.98	0.70	2.68	0.04	2.64
2012	4.33	3.89	0.44	0.39	0.38	0.75	2.32	0.15	2.31	0.77	3.08	0.06	3.01
2013	4.51	4.18	0.33	0.42	0.56	0.75	2.74	0.18	2.51	0.97	3.49	0.04	3.44
2014	5.57	5.29	0.28	0.55	0.63	0.88	3.44	0.34	3.14	1.18	4.32	0.05	4.27
2015	5.75	5.28	0.47	0.70	1.09	1.21	3.81	0.35	3.23	1.79	5.02	0.05	4.97
2016	5.23	4.81	0.42	0.83	0.96	1.26	3.76	0.31	3.23	1.79	5.01	0.04	4.97
2017	5.94	5.43	0.51	0.96	0.78	1.31	3.92	0.33	3.49	1.74	5.23	0.04	5.18

Table 2. Financial and economic coefficients contributing to the integral coefficient of sustainable development

Year	Current liquidity	Autonomy ratio	Coefficient of validity of fixed assets	Flexibility ratio	Dividend yield (%)	Asset turnover ratio	Asset profitability ratio
2008	1.48	0.70	0.95	0.31	5.36	1.64	0.19
2009	1.84	0.71	0.94	0.32	3.44	1.20	0.12
2010	1.91	0.71	0.93	0.35	3.75	1.26	0.14
2011	2.12	0.74	0.93	0.35	4.59	1.50	0.14
2012	1.95	0.75	0.94	0.33	4.88	1.50	0.14
2013	1.79	0.72	0.93	0.30	5.53	1.37	0.09
2014	1.60	0.73	0.90	0.28	7.56	1.43	0.06
2015	1.75	0.64	0.91	0.38	6.90	1.23	0.09
2016	1.51	0.64	0.92	0.39	6.90	1.04	0.08
2017	1.36	0.67	0.92	0.37	7.00	1.16	0.10
$\underline{n}$	1.73	0.70	0.93	0.34	5.59	1.33	0.12
opt.	[1.5–2.5]	[0.6–0.7]	≥ 0.5	[0.2–0.5]	> 0	> 0	> 0

Table 3. Largest Russian companies by capitalization at the beginning of 2018

Rating	Company	Capitalization, bln USD
1	Sberbank	84.311
2	Gazprom	53.349
3	Rosneft	53.304
4	Lukoil	48.993
5	Novatek	35.543

Table 4. Baseline data for building a correlation-regression model of sustainable development of PJSC LUKOIL (PJSC LUKOIL, 2018)

Year	Capitalization (trillion rubles)	USD/RUB	Inflation (%)	Dividend yield (%)	Profit (trillion

					rubles)
2008	0.817	24.86	11.9	5.36	0.34
2009	1.440	31.83	13.3	3.44	0.31
2010	1.481	30.36	8.8	3.75	0.35
2011	1.448	29.39	6.1	4.59	0.39
2012	1.701	31.08	7.0	4.88	0.44
2013	1.735	31.85	6.7	5.53	0.33
2014	1.892	38.61	11.4	7.56	0.28
2015	1.995	61.07	12.0	6.81	0.47
2016	2.933	66.08	6.5	6.94	0.42
2017	2.836	58.29	5.2	7.28	0.51

Table 5. Calculated values of the of the equation system elements

t.	y	x_1	x_2	x_3	x_4	y^2	x_1^2	x_2^2	x_3^2	x_4^2	x_1x_2	x_1x_3	x_1x_4	x_2x_3	x_2x_4	x_3x_4	yx_1	yx_2	yx_3	yx_4
1	0.82	24.86	11.9	5.36	0.34	0.67	618.02	141.61	28.73	0.12	295.83	133.25	8.47	63.78	4.06	1.83	20.31	9.72	4.38	0.28
2	1.44	31.83	13.3	3.44	0.31	2.07	1013.15	176.89	11.83	0.10	423.34	109.50	9.91	45.75	4.14	1.07	45.84	19.15	4.95	0.45
3	1.48	30.36	8.8	3.75	0.35	2.19	921.73	77.44	14.06	0.12	267.17	113.85	10.63	33.00	3.08	1.31	44.96	13.03	5.55	0.52

4	1.45	29.39	6.1	4.59	0.39	2.10	863.77	37.21	21.07	0.15	179.28	134.90	11.36	28.00	2.36	1.77	42.56	8.83	6.65	0.56
5	1.70	31.08	7	4.88	0.44	2.89	965.97	49.00	23.81	0.19	217.56	151.67	13.59	34.16	3.06	2.13	52.87	11.91	8.30	0.74
6	1.74	31.85	6.7	5.53	0.33	3.01	1014.42	44.89	30.58	0.11	213.40	176.13	10.39	37.05	2.19	1.80	55.26	11.62	9.59	0.57
7	1.89	38.61	11.4	7.56	0.28	3.58	1490.73	129.96	57.15	0.08	440.15	291.89	10.62	86.18	3.14	2.08	73.05	21.57	14.30	0.52
8	2.00	61.07	12	6.81	0.47	3.98	3729.54	144.00	46.38	0.22	732.84	415.89	28.44	81.72	5.59	3.17	121.83	23.94	13.59	0.93
9	2.93	66.08	6.5	6.94	0.42	8.60	4366.57	42.25	48.16	0.18	429.52	458.60	27.70	45.11	2.72	2.91	193.81	190.06	20.36	1.23
10	2.84	58.29	5.2	7.28	0.51	8.04	3397.72	27.04	53.00	0.26	303.11	424.35	29.52	37.86	2.63	3.69	165.31	14.75	20.65	1.44
Σ	18.28	403.42	88.9	56.14	3.82	37.14	18381.63	870.29	334.78	1.51	3502.2	2410.1	160.6	492.6	32.9	21.8	815.8	153.6	108.3	7.23
n	1.83	40.34	8.89	5.614	0.38	3.71	1838.16	87.029	33.48	0.15	350.22	241.00	16.06	49.26	3.30	2.18	81.58	15.36	10.83	0.72

Table 6. Regression statistics

Results	
Multiple R	0.963425221
R square	0.928188156
Normalized R square	0.87073868
Standard error	0.231496597
Observations	10

Table 7. Deviations of the actual values of the performance criterion from the theoretically calculated ones

	y	$\hat{y}$	$y-\hat{y}$	$\left\|\frac{y-\hat{y}}{y}\right\| \cdot 100$
1	0.82	1.00	- 0.18	22.26
2	1.44	1.22	0.22	15.44
3	1.48	1.50	- 0.02	1.56
4	1.45	1.64	- 0.19	13.28
5	1.70	1.51	0.19	11.28
6	1.74	1.81	- 0.07	4.23
7	1.89	1.73	0.16	8.58
8	2.00	2.16	- 0.16	8.11
9	2.93	2.99	- 0.05	1.83
10	2.84	2.61	0.23	8.08
Σ	18.28	18.16	0.12	94.65
$\underline{n}$	1.83	1.82	0.01	9.47

Table 8. Paired and inter-factor correlation coefficients

	y	x_1	x_2	x_3	x_4
y	1.00	0.89	- 0.52	0.67	0.58
x_1	0.89	1.00	- 0.21	0.71	0.65
x_2	- 0.52	- 0.21	1.00	- 0.16	- 0.5
x_3	0.67	0.71	- 0.16	1.00	0.34
x_4	0.58	0.65	- 0.5	0.34	1.00

Table 9. Baseline data for building a three-factor correlation-regression model (Mau, 2016)

Year	Capitalization (trillion rubles)	USD/RUB	Inflation (%)	Profit (trillion rubles)
	y	x_1	x_2	x_3
2008	0.817	24.86	11.9	0.34
2009	1.440	31.83	13.3	0.31
2010	1.481	30.36	8.8	0.35
2011	1.448	29.39	6.1	0.39
2012	1.701	31.08	7.0	0.44
2013	1.735	31.85	6.7	0.33
2014	1.892	38.61	11.4	0.28
2015	1.995	61.07	12	0.47
2016	2.933	66.08	6.5	0.42
2017	2.836	58.29	5.2	0.51

Table 10. Paired and inter-factor correlation coefficients

r_{yx_1}	r_{yx_2}	r_{yx_3}	$r_{x_1x_2}$	$r_{x_1x_3}$	$r_{x_2x_3}$
0,89	- 0,52	0,58	- 0,21	0,65	- 0,5

Table 11. Regression statistics (Hamilton, 2009)

Results	
Multiple R	0.963404467
R square	0.928148167
Normalized R square	0.89222225
Multiple R	0.211385345
Observations	10

Table 12. Deviations of the actual values of the performance criterion from the model

It.	y	$\hat{y}$	$y - \hat{y}$	$\left\|\frac{y - \hat{y}}{y}\right\| \cdot 100$
1	082	101	- 019	2312
2	144	121	023	1569
3	148	150	- 002	151
4	145	164	- 020	1360
5	170	152	018	1084
6	174	182	- 008	466
7	189	175	015	773
8	200	217	- 018	901
9	293	300	- 007	242

10	284	263	021	732
Σ	1828	1825	002	9589
$\underline{n}$	183	183	000	959

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