THE MODEL TO ASSESS ECONOMIC SECURITY OF FUEL AND ENERGY COMPLEX ENTERPRISES OF THE NORTHERN RESOURCE-PRODUCING REGION TAKING INTO ACCOUNT THE BEHAVIORAL ASPECT

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ABSTRACT

The article reflects the research results of the influence of behavioral aspects on the level of economic security of the fuel and energy complex enterprises of the northern resource-producing region. The authors conducted review of models to assess the economic security of enterprises in various industries; considered different viewpoints on the impact of behavioral aspects on managerial decisions; substantiated the importance of economic security of the fuel and energy complex enterprises, and proposed the model of economic security assessment for these enterprises.

The level of economic security is determined by calculating an integrated index that includes various types of security. The state of each type of security is found as the arithmetic mean of the deviations of the actual values of security indicators from the threshold values. The article presents the gradation of the levels of economic security of the fuel and energy complex enterprises of the northern resource-producing region, their characteristics and measures necessary to improve or maintain the economic security of the enterprise, taking into account the behavioral aspect.

Keywords: economic security, fuel and energy complex, behavioral economy, model of economic security, northern resource-producing region.

1. INTRODUCTION

In contemporary conditions of economic entities' functioning, which are characterized by the instability of the environment, threats from competitors, and the imposition of international economic sanctions, the issue of providing economic security of enterprises remains highly relevant. At all stages of economic development, enterprises remain the main economy element and represent an open dynamic system [1], acting under the impact of numerous factors. Consequently, their successful functioning influences the economic security of other levels (industry, region, and country).

The importance of economic security of the fuel and energy complex enterprise of the northern resource-producing region is due to many factors:

1. The fuel and energy complex is one of the most strategically important complexes [2], which has manufacturing relations with all branches of the real sector of the economy, namely electrical, metallurgical, chemical, manufacturing, consumer goods industry, etc.

2. The proportion of fuel and energy complex in the structure of GRP of Khanty-Mansi Autonomous Okrug-Yugra (KhMAO-Yugra) according to Federal State Statistics Service (Rosstat) is more than 70%.

3. The proportion of KhMAO-Yugra in the all-Russian oil production in 2017 amounted to 43% [3].

4. Khanty-Mansi Autonomous Okrug-Yugra is a leader in terms of power plant output (second after Krasnoyarsk Territory), which is characterized by positive dynamics. The absolute gain of KhMAO-Yugra in 2001 amounted to 5.8 mln kW [4] a leader in electricity production in Russia (Rosstat).

Due to the fact that the Khanty-Mansi Autonomous Okrug is one of the largest oil-producing regions in the world, it belongs to the donor regions of Russia and is the leader in a number of key economic indicators such as oil production, electricity production, industrial production, and natural gas output. It is practically significant that KhMAO-Yugra ensures the economic security of the fuel and energy complex enterprises of the northern resource-producing region.

To achieve this goal, it is necessary to propose an optimal model for assessing the economic security of the fuel and energy complex enterprises in order to timely prevent and neutralize threats, taking into account the achievements of modern economic science.

METHODS

The discussions concerning the economic security in its contemporary sense started in Russia since 90-ies of the XXth century in connection with the transformation crisis, accompanied by a drop in production, and the destruction of the cooperative relations' system [5], and, as a result, the adoption of the State strategy of economic security of the Russian Federation in 1996. Even then, many definitions and approaches to the consideration of this concept were formed, however the official documents of the Russian Federation such as the Federal law "On security" and "Strategy of national security of the Russian Federation" lack such object of security as an economic entity. The concept of "economic security of the enterprise" has no unambiguous definition, which is due to the use of different approaches to the consideration of this phenomenon.

In this study, the economic security of the enterprise is understood as ensuring the most effective use of corporate resources to prevent threats and create conditions for the stable functioning of its main elements [6].

Based on the above definition, the economic security of the enterprise includes several elements such as financial, production and sales, innovation, and human resources [7], as well as political and legal, environmental, social, technical and technological, information and coercive components [8].

To ensure the economic security of an economic entity, many authors propose various models that allow assessing the level of economic security of the enterprise in order to prevent and neutralize the most dangerous and/or probable threats. The most popular are the models of integrated assessment of economic security of the enterprise based on the calculation of the integrated index. Thus, the integrated index of enterprise's corporate security (AI_{ECS}) is defined as the weighted average of consolidated security indicators of functional components (1), such as financial, human recourses, technological, informational, legal, commercial, ecological, power, and intellectual components:

$$AI_{ECS} = \sum_{i=1}^{9} CI_{SFC} \times d_i, \tag{1}$$

where: CI_{SFC} is the values of the consolidated security indicators of the enterprise's functional components; d_j is the weighted coefficients of the functional components of corporate security of the enterprise, $\sum_{i=1}^{9} d_i = 1$ [9].

To determine the state of economic security, the latter is divided into 5 levels (critical, minimum, average, high, and maximum level) on a scale from 0 to 100 points.

The advantage of using an integrated index of economic security of the enterprise is a systematic approach to its consideration. Assessing the level of economic security based on calculation of the integral estimation can be done by the formula (2):

$$P = (\sum_{j=1}^{m} a_j L_j)/m, \tag{2}$$

where P is an integrated index of economic security; L_j is the value of the j economic security index; a_j is the weighting factor determining the significance of a particular indicator; m is the number of indicators selected for the assessment [10].

In order to determine the level of economic security of the enterprise, the obtained estimation is compared with the integrated index of the region's threshold values.

Another model of the integrated indicator of economic security of the enterprise based on functional components, which in addition to the internal components (financial, production and technological, intellectual and human resources, marketing, and power) include also external components (interface, innovation and technological, institutional and legal, resource and energy, and environmental), has the following form:

$$I_i^{\Sigma} = \sqrt{w_j \sum_{j=1}^{k} (1 - \frac{\overline{x_J}}{x_{max}})^2}, \tag{3}$$

where: I_i^{Σ} is the integral estimation of an individual indicator by the i-th functional component;

w_j is the weighted coefficient of significance of the j-th indicator of the i-th functional component; k is the number of indicators of the i-th functional component of the economic security of enterprises [11].

The conclusion about the level of economic security is made by comparing the obtained value with the reference value (for example, the average for the industry or region).

One of the major tasks of determining the level of economic security is diagnosing the enterprise's activities in order to identify deviations from the threshold values and make appropriate managerial decisions. A model of multicircuit diagnostics can serve as the tool for solving this problem [12]. The model includes 4 stages:

- express diagnostics (analysis of financial indicators);
- general diagnostics (analysis of factors of production, operating efficiency, causes of crisis phenomena);
- comprehensive diagnostics (management system assessment);
- System diagnostics (building a business model and criteria system).

Also, to determine the level of economic security of enterprises, it is proposed using formulas to calculate operating performance indicators [1] that will allow taking timely measures to improve production efficiency and technology. These indicators include production output, financial safety margin, and operating leverage.

According to the authors, the application of these models in practice has some difficulties and disadvantages, such as, for example:

- what to follow when determining weighted coefficients of the functional components in the model (1);
- how to determine the significance of one or another indicator in models (2) and (3);
- the assessment of economic security through the use of a multicircuit diagnostic model includes the analysis of such activity areas of the enterprise which can be estimated only while in the environment of an economic entity (corporate culture, reflective properties, institutionalization of decision-making, etc.);
- The calculation of operating performance indicators affects just financial and operational security.

Also, considering the economic activity of the enterprise, it is necessary to take into account that it is the human, who determines the basic laws of the economy functioning, makes managerial decisions based on their preferences, expectations, knowledge, and calculations. Therefore, according to the authors, the economic security of the enterprise should be considered not only from the standpoint of financial condition and stability, but also in view of the behavioral aspect.

Thus, most of the indicators that characterize the financial security of enterprises, such as liquidity, financial stability, business activity, as well as bankruptcy, depend on the structure of their capital. The capital structure, in turn, depends on the decisions made by top managers. Capital structure of an enterprise can be influenced by personal qualities of a manager such as self-confidence [13] and biased optimism [14; 15], while market competition [16] pushes the company's management to copy financial leverage from industry leaders.

The founders of behavioral economy note that the manager is guided by a set of rules that allow him to make a conditionally optimal decision. For example, when considering candidates for a vacant position, manager evaluates the capabilities of candidates and applies his forecasting abilities [17]. Accordingly, the candidate, who has successfully passed the manager's test, will be given the proper job. However, we cannot be sure that the high potential of the candidate will be successfully implemented in the course of his work that may affect personnel security. Besides, manager's beliefs play an important role when making decisions and processing information [17].

Considering the behavioral aspect in the organization, Herbert Simon notes the banality of decisions made by managers, which is due to the multitasking character of their activities, limited mental capacity and uncertainty of the environment. As a result, the main goal of the organization is solving emerging problems rather than maximizing profits [18]. Also Simon argues that there are many factors that affect the effectiveness of the organization, however "only some of the most obvious factors can be taken into account at any given point in time"

[19]. At that, these factors are constantly changing under the influence of the internal and external environment. That is, the indicators that are included in the model of economic security of the enterprise may have different degree of importance in different periods of its economic activity, which indicates the need for their constant revision.

RESULTS

Given the importance of the smooth functioning of the fuel and energy complex enterprises to ensure economic security, the company management should promptly identify threats in order to minimize possible negative consequences, that is, the level of economic security of the enterprise directly depends on what managerial decisions will be taken by managers. Based on this, it is proposed to include in the model in addition to conventional indicators, the indicators that reflect behavioral factors which have greater impact on the components of economic security of the enterprise (Table 1).

Table 1 System of economic security indicators of the enterprise

Conventional indicators		Indicators that take into account the behavioral aspect	
Indicator	Threshold value	Indicator	Threshold value
Energy security			
Proportion of own generation and use of secondary energy sources, %	>65	Availability and implementation of energy saving and energy efficiency improvement program	yes
Specific energy intensity of the enterprise's products, %	≤3		
Proportion of energy component in the cost of production for energy security, %	≥30		
Financial security			
Depreciation ratio of fixed assets	<0.5	Financial leverage	<1
Return on total assets	>0.13		
Product profitability	>0.1	Coefficient of financial strains	<0.5
Asset turnover ratio	>5		
Cover ratio	≥2	Ratio of accounts receivable to accounts payable	1
Funding ratio	≥1		
Solvency ratio	>1		
Personnel security			
Proportion of engineering and scientific staff	≥0.9	Internal mobility rate	10%
Staff turnover rate	<5%	Availability and execution of the internship program	yes
Indicator of inventive activity	≥0.75		
Indicator of educational level	≥1	Availability and execution of the social programs	yes
Indicator of the rate of remuneration	≥1		
Production and sales security			
Capital productivity	>5	Ratio of renewal and disposal of fixed assets	>1
Capacity utilization level, %	>85		
Product sales growth rate	>100		
Product quality	≥1	Level of production diversification	>1
Rate of change in the company's market share	≥1		
Indicator of the enterprise's adaptive capabilities to market changes	≥1		
Ecological safety			
Environmental pollution rate	<1	Payment of fines for environmental offenses in the absence of costs for environmental protection measures	no

Note: Developed by the authors based on [11; 20; 21]

Due to the fact that the largest proportion in the structure of power consumption of KhMAO-Yugra falls on industrial consumers, which is more than 86.3% [22], it is considered appropriate to include in the model a peculiar component of economic security of the fuel and energy complex enterprises such as security of energy supply (energy security). In the model it is proposed to consider the part of the indicators proposed by M. Gaifullina et al 20], because some of them are suitable for the assessment of safety of oil companies only, as well as to add an indicator of the availability and fulfillment of the energy saving and energy efficiency program, the implementation of which will allow less consumption of energy resources while maintaining the performance indicators of the economic entity.

In addition to the inclusion of a specific component, indicators that take into account the behavioral aspect will be added to each type of security.

Thus, it is proposed to supplement the indicators of the financial component in the model (3) with indicators such as the financial leverage, coefficient of financial strains, and ratio of accounts receivable to accounts payable, which directly depend on the decisions of senior managers regarding to the financing sources of the company's activities.

Group of the personnel component indicators will be supplemented by indicators of internal mobility and social programs (packages), taking into account the level of employee motivation. Also, according to the authors, it is advisable to include in the model the indicator reflecting the availability and performance of internship programs that will minimize such a threat to human security as the hiring by the manager of the candidate for the vacant position, based only on the assessment of his potential by standard methods (questioning, interview), which do not always allow identifying the "working efficiency" of the applicant. Accordingly, if an economic entity organizes internships for job applicants, this indicator will be equal to 1, otherwise – to 0.

It is proposed to include the indicator of "Payment of fines for environmental offenses in the absence of costs for environmental protection measures" into the group of ecological safety indicators, because the excess of pollution limits due to lack of environmentally friendly technologies in the company may be caused due to managers' opinion concerning the higher cost of such equipment in comparison with the amount of accrued fines.

Production-technological and marketing components will belong to the same kind of security, namely production and sales, and will be complemented by the indicators of production diversification and coefficients of renewal and disposal of fixed assets.

The calculation of the integrated index of economic security will be based on the indicator approach, and will include the following steps:

1. Calculation of indicators characterizing different types of enterprise security.
2. Definition of threshold values for each indicator.
3. The estimation of the deviation of the actual value of each indicator with regard to the threshold value should be made by the following formulas:

   - if the optimization direction of the indicator is max:

$$x_i = \frac{a_i}{a_i^n}, \tag{4}$$

   - if the optimization direction of the indicator is min:

$$x_i = \frac{a_i^n}{a_i}, \tag{5}$$

where: a_i is the actual value of the indicator; a_i^n is the threshold value of the indicator [21].

4. The level of each type of economic security (S) is calculated by the formula (6):

$$S_t = \frac{\sum_{i=1}^{n} x_i}{n},$$

(6)

where x_i is the value of the index-indicator; t is the type of enterprise security; N is the number of index-indicators reflecting a particular type of enterprise security.

The closer the value S_t to 1 is, the higher the level of one or another economic security of the enterprise is.

5. The general level of economic security of the fuel and energy complex enterprise is determined by the formula (7):

$$ES = \sum_{t=1}^{N} S_t,$$

(7)

where N is the number of enterprise security types.

It is proposed to make conclusion about the level of economic security of the fuel and energy complex enterprise on a 5-point scale (based on the number of enterprise security types), presented in Table 2.

Table 2 Gradation of economic security levels of fuel and energy enterprises

Sl. No	Interval	Description	Measures
	From 0 to 1	Critical level of economic security. All or most of the indicators are smaller than the threshold values, or have exceeded the limits towards deterioration.	The company needs urgent measures to eliminate threats of all security types. It is necessary to review the competence of the enterprise managers.
	From 1 to 2	Dangerous level of economic security. The majorities of indicators are less than the threshold values, or have exceeded their limits towards deterioration.	The enterprise needs urgent measures to eliminate threats of certain types of security. It is necessary to review the competence of managers responsible for a certain field of enterprise activity.
	From 2 to 3	An alarming level of economic security. Some of the indicators have reached the threshold values, and some have exceeded their limits towards deterioration.	The enterprise needs in the near future measures to eliminate threats of certain security types. It is necessary to review the individual decisions of managers responsible for a certain fields of enterprise activity.
	From 3 to 4	Stable level of economic security. The majority of the indicators have reached the threshold values or exceeded them towards improvement.	It is necessary to maintain most types of economic security at the achieved level while reconsidering the decision-making of managers responsible for those types of security, which have not reached the threshold values.
	From 4 to 5	High level of economic security. All indicators have reached the threshold values, or most of them have exceeded towards improvement.	It is necessary to maintain economic security at the achieved level. Managers respond quickly to the challenges of the external environment and make reliable management decisions.

Note: Table is developed by the authors based on [8]

Below is an example of approbation of the offered model to estimate the level of economic security of fuel and energy enterprises of the northern resource-producing region, taking into account the behavioral aspect. The investigated enterprise operates in the gas industry of the Khanty-Mansi Autonomous Okrug-Yugra. The actual data of economic security indicators of the enterprise are presented in Table 3.

Table 3 Initial data for the assessment of economic security of the enterprise

Sl. No	Title of the index-indicator	2015	2016	2017	Threshold value
	Financial security				
	Depreciation ratio of fixed assets	0.55	0.52	0.53	<0.5
	Return on total assets	-0.062	-0.013	0.017	>0.13
	Product profitability	-0.272	-0.175	-0.181	>0.1
	Asset turnover ratio	0.412	0.373	0.417	>5
	Cover ratio	0.796	0.711	0.850	≥2
	Funding ratio	1.42	2.19	2.79	≥1
	Solvency ratio	0.995	1.004	1.014	>1
	Financial leverage	-0.0003	-0.0005	-0.005	<1
	Coefficient of financial strains	0.413	0.313	0.26	<0.5
	Ratio of accounts receivable to accounts payable	0.58	0.49	0.61	1
	Personnel security				
	Staff turnover rate	2	2	1	<5%
	Proportion of engineering and scientific staff	0.8	0.82	0.82	≥0.9
	Indicator of inventive activity	0	0	0	≥0.75
	Indicator of educational level	0.9	0.9	0.94	≥1
	Indicator of the rate of remuneration	0.74	0.7	0.65	≥1
	Internal mobility rate	1	1	1	10%
	Availability and execution of the internship program	no	no	no	yes
	Availability and execution of the social programs	no	no	no	yes
	Production and sales security				
	Capital productivity	0.639	0.500	0.549	>5
	Capacity utilization level, %	75	74	67	>85
	Product sales growth rate	81.74	97.77	96.17	>100
	Product quality	1	1	1	≥1
	Rate of change in the company's market share	1	1	1	≥1
	Indicator of the enterprise's adaptive capabilities to market changes	0.5	0.5	0.5	≥1
	Ratio of renewal and disposal of fixed assets	1.98	0.061	0.037	>1
	Level of production diversification	0.8	0.8	0.8	>1
	Energy security				
	Proportion of own energy generation and the use of secondary energy sources, %	38	34	34	>65
	Specific energy intensity of the enterprise's products, %	27.2	31.9	36.1	≤3
	The proportion of energy component in the cost of production for energy security, %	21.3	27.1	30.4	≥30
	Availability and implementation of energy saving and energy efficiency improvement program	no	no	no	yes
	Ecological safety				
	Environmental pollution rate	0.0005	0.0004	0.0005	<1
	Payment of fines for environmental offenses in the absence of costs for environmental protection measures	no	no	no	no

The calculation results of the integrated index of economic security of the energy complex enterprise are presented in Table 4.

Table 4 Assessment of the economic security level of the fuel and energy complex enterprise

Year	Financial security	Personnel security	Production and sales security	Ecological safety	Energy security	Total level of economic security
2015	0.24	0.641	0.888	0.999	0.351	3.119
2016	0.482	0.639	0.664	0.999	0.38	3.164
2017	0.61	0.95	0.649	0.999	0.4	3.608

In 2015 and 2016, the enterprise was on the verge of transition from a stable level of economic security to an alarming level, which was due to low financial and human security indicators, as well as a drop in production and sales security. According to the results of 2017, the growth of the economic security level was 15.7% (the level was still stable). The enterprise had significantly improved the indicators of personnel and financial security, as well as the level of energy security. The company management was recommended to review the decisions of managers responsible for the production and sales security. Also, despite the growth of financial security indicators, its level remained quite low. Greater negative impact on the level of financial security was caused by the profitability ratios, therefore, financial managers needed to analyze the profit (loss) structure and identify the most and the least profitable (loss-making) activities in order to change the economic portfolio of the enterprise.

In the field of energy security, managers were recommended to develop a program for energy saving and energy efficiency that would allow reducing the energy intensity of products. This indicator directly depends on the financial security indicators, namely depreciation and renewal ratios of fixed assets, because the increase in energy efficiency is possible only with the modernization and renewal of fixed assets of the enterprise, as well as with the availability of corresponding funds that is reflected by the financing ratio and coefficient of financial strains. That is, the level of financial and energy security of the enterprise depends on what capital structure is formed by the financial manager.

It should be noted that in 2017 there were personnel changes, namely chief accountant was changed in April, while Director General – in June, 2017. This confirms the impact of behavioral aspects on the level of economic security of the enterprise.

CONCLUSION

The review of the models to assess economic security has shown that the existing models do not take into account the specifics of the fuel and energy complex enterprises, and also are associated with a number of difficulties and shortcomings in their practical application. The authors have considered the factors that determine the need to ensure economic security of the fuel and energy complex enterprises of the northern resource-producing region, as well as improved the model for assessing the level of economic security for these economic entities.

In addition to the main indices, the model has been supplemented by the indicators that reflect the level of energy security, as well as indicators that take into account the behavioral aspect, which is relevant for modern economic science. The list of indicators of enterprises' economic security, considered in the proposed model, is not closed and can be supplemented by other indicators, including those that take into account the specifics of each particular industry.

In consequence of the study, a gradation of the economic security levels of the fuel and energy complex enterprises was proposed along with their characteristics, and recommendations were developed for making decisions on neutralizing and preventing threats. In addition, the proposed model was tested through the example of the enterprise in Khanty-Mansi Autonomous Okrug-Yugra, which operated in the gas industry. Conducted assessment resulted in obtaining the relationship between the behavior of managers of the company and the state of economic security as well as its constituent components. Therefore, it is theoretically and practically important to continue further research on the influence of behavioral aspects on the level of economic security of enterprises.

ACKNOWLEDGEMENTS

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