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Financial and economic security of business as a primary element in the economic system: Calculation of the integrated indicator of economic security

Seguridad financiera y económica de las empresas como elemento primordial del sistema económico: Cálculo del indicador integrado de seguridad económica

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Content

ABSTRACT:

This article outlines the basis of formation of socio-economic indicators system providing economic security of a business through application in the future of neural networks as the primary element of economic system to create investment platforms, develop and support the next generation system for regulation of production. This is done by systematizing indicators, using cognitive technologies and decomposition of the factor space, justifying the fundamental factors in real time with due account for the effect of integration, globalization and modern challenges that create a new round of risks, threats, and hazards, poorly understood to date. The main purpose of this article consists in calculating

RESUMEN:

Este artículo describe las bases de la formación del sistema de indicadores socioeconómicos proporcionando la seguridad económica de un negocio a través de la aplicación en el futuro de las redes neuronales como elemento primario del sistema económico para crear plataformas de inversión, desarrollar y apoyar el sistema de próxima generación para la regulación de la producción . Esto se hace sistematizando indicadores, utilizando tecnologías cognitivas y descomponiendo el espacio de factores, justificando los factores fundamentales en tiempo real, teniendo debidamente en cuenta el efecto de la integración, la globalización y los desafíos modernos que crean una nueva ronda de

coefficients characterizing economic security of Public Joint Stock Company "Severstal" (PAO Severstal). This includes calculating integrated indicator of economic security, determining the trends in the dynamics of the integrated indicator of economic security and its components at PAO Severstal in 2014-2016, comparing the calculation of the integrated indicator of economic security with and without taking into account the weighting coefficients. The main conclusions of this work can be formulated as follows: 1. The calculation of the integrated indicator of economic security at PAO Severstal has shown that this indicator does not depend significantly on weighting coefficients. The best values of the integrated indicator of economic security were defined for III, II and IV quarters of 2015 without taking into account the weighting coefficient of cumulative indicators, and for III, IV and II quarters of 2015 – with the use of weighting coefficient. The worst level of economic security was noted in I and IV quarters without taking into account the weighting coefficient. While, if used, these quarters swap places. Comparing them with statutory values, we see that the obtained data are below statutory value of the integrated indicator of economic security, no matter whether weighting coefficients were used or not. 2. Adequate mathematical models to be used for the economic security management require a comprehensive accounting of uncertainty factors associated with the specifics of business operation in modern economy conditions.
Key words: economic security, financial sustainability of business, weighting coefficients, formation of indicators based system to assess the level of economic security.

riesgos, amenazas y peligros, Poco entendido hasta la fecha. El objetivo principal de este artículo consiste en calcular los coeficientes que caracterizan la seguridad económica de la Sociedad Anónima Pública "Severstal" (PAO Severstal). Esto incluye el cálculo del indicador integrado de seguridad económica, determinando las tendencias de la dinámica del indicador integrado de seguridad económica y sus componentes en PAO Severstal en 2014-2016, comparando el cálculo del indicador integrado de seguridad económica con y sin tener en cuenta la Coeficientes de ponderación. Las principales conclusiones de este trabajo pueden formularse de la siguiente manera: 1. El cálculo del indicador integrado de seguridad económica en PAO Severstal ha mostrado que este indicador no depende significativamente de los coeficientes de ponderación. Los valores óptimos del indicador integrado de seguridad económica se definieron para los trimestres III, II y IV de 2015 sin tener en cuenta el coeficiente de ponderación de los indicadores acumulativos y para los trimestres III, IV y II de 2015 con el uso del coeficiente de ponderación. El peor nivel de seguridad económica se observó en los trimestres I y IV sin tener en cuenta el coeficiente de ponderación. Si bien, si se usan, estos lugares cambian de lugar. Comparándolos con los valores estatutarios, vemos que los datos obtenidos están por debajo del valor legal del indicador integrado de seguridad económica, independientemente de si se utilizaron coeficientes de ponderación o no. 2. Los modelos matemáticos adecuados que se utilizarán para la gestión de la seguridad económica requieren una contabilidad completa de los factores de incertidumbre asociados con los aspectos específicos de la operación del negocio en las condiciones de la economía moderna.
Palabras clave: seguridad económica, sostenibilidad financiera de los negocios, coeficientes de ponderación, formación de un sistema basado en indicadores para evaluar el nivel de seguridad económica.

1. Introduction

Financial and economic security of the business is the primary element of the economic system, including that at the national level.

The study of the theory of economic security was significantly contributed by foreign scientists: J. Azoulay, V. Pareto, A. Esau, B. Hager, A. Brown, and many others (Kunitsyn, A.V., 1998; Mikhalkin, V.A., 1990; Romadina, L.N., 2008; Yakunin, et. al. 2008; A set of guidelines for socio-economic cost benefit analysis of transport infrastructure project appraisal, 2003; Azoulay 2010; Breidinger 2006; Brown, n. d.; Sutnata and Byrd 2007; D'Agostino 2008; Murray and Grybeste 2007; Friest 2007; Sullivaut 2007).

The evaluation of economic-financial security of business, theoretical and methodological approaches to ensure the financial security of business are studied in many works of Russian and foreign scientists: A. Baranowski, I. Blank, L. Borshch, K. Goryacheva, G. Vechkanov, V. Vorobiev, A. Gukova, E. Oleynikov, R. Papekhin, Yu. Pogosov (Baranovsky 2000; Blank 2004; Vechkanov 2007; Gukova and Anikin 2006; Oleynikov 2005; Papekhin 2007; Pogosova and Lebedev 2014), etc. Though problems on financial and economic security of business are considered fragmentary and definitely require further research.

Financial and economic security of the state was researched by famous scientists and practitioners, though it is poorly studied in terms of the consolidation of business and public administration of economic and financial security of business. The study in the framework of **Financial and economic security of business as a primary link in the economic system**, carried out based on (Burkaltseva, D.D., 2012; Borsch, et. al. 2016; Oleynikov, et. al. 2005;

The main components and the direction to ensure the economic security of the enterprise; Burkaltseva, et. al. 2016; Dudin, et. al. 2014; . Dudin, et. al. 2016; Borsch, et. al. 2016a; Vivchenko 2013; Burkaltseva, et. al. 2016a; Goryacheva 2006; Dudin, et. al. 2015) led to the comprehension of the relevance of the security issue at the micro, meso, macro, and mega levels, and defined the purpose and subject of the present article.

2. Methodology

In this article, when calculating the integrated indicator of economic security, determining the dynamics trends of the integrated indicator of economic security and its components at PAO Severstal in 2014-2016, comparing calculated values of integrated index of economic security with and without taking into account the weighing coefficient, we used the analysis, comparison, as well as ratio analysis, graphical, statistical and economic-mathematical methods.

3. Results

Suitable mathematical models to manage economic security require a comprehensive accounting of all uncertainty factors associated with the specifics of business operation under current management conditions. The effect of these factors makes it difficult to obtain correct and reasonable solutions, determines the practical importance of fuzzy data processing and the need to use fuzzy-set approach [29].

To assess the level of business economic security, it is necessary to establish a system of socio-economic indicators with the further use of neural networks (Table 1).

Table 1. The system of socio-economic indicators characterizing the level of business economic security

Indicators	Optimization trend	Statutory values
The ratios of financial status		
1. The share of circulating assets in the property	increase	0.5
2. The share of receivables in assets	increase	0.20
3. The mobile assets ratio	increase	1
4. The growth rate of business property	increase	1.025
5. The growth rate of current assets	increase	1.0125
The ratios of liquidity and solvency		
1. Absolute liquidity ratio	the best condition 0.2 - 0.3	0.2-0.3
2. The refined (intermediate) liquidity ratio	the best condition 0.7 - 0.8	0.7-0.8
3. The current liquidity ratio	the best condition 1.0 - 2.0	1.0-2.0

4. The solvency ratio	increase	0.50
The ratios of financial independence		
1. Equity to total assets	increase	0.5
2. Financing ratio	increase	1
3. Stable funding sources concentration ratio	increase	0.85
The ratios of financial soundness		
1. The growth rate of invested working capital	increase	1.025
2. The collateralization ratio of current assets by invested capital	increase	0.2
3. The maneuverability of the working capital	increase	0.3
The ratios of business activity		
1. The asset turnover ratio	increase	0.25
2. The current assets turnover ratio	increase	0.5
3. The inventory turnover ratio	increase	1
4. The receivable turnover accounts ratio	increase	3
5. The equity capital turnover ratio	increase	0.5
6. The payable turnover ratio	increase	3
7. The duration of the production cycle	increase	60
8. The duration of the financial cycle	increase	45
Profitability performance profile (ROI)		
Return on equity		
1. Return on assets (ROA)	increase	0.0175
2. Return of equity (ROE)	increase	0.025
3. Utilization efficiency of circulating assets	increase	0.025
Profitability of sales		

4. Gross sales effectiveness	increase	0.2
5. Sales operating performance	increase	0.1
6. The net impact of sales	increase	0.05

It should be noted that the statutory values are determined for the coefficients calculated per quarters.

After ratios calculation they must be reduced to comparable quantities. To do this we used the following formulas (Blazhevich 2010):

if the optimization indicator tends to increase:

$$x_i = a_i / a_i^n ;$$

(1)

if the optimization indicator tends to decrease:

$$x_i = a_i^n / a_i ,$$

(2)

where ai – is the actual value of the ratio; a_i^n – is the statutory value of the same ratio.

It is also necessary to calculate the integrated indicator for each group by summing up the reduced values. The integrated indicator, when comparing it with the statutory value, which equals to the number of reduced indicators in the group, is used to assess the status of a particular group.

The integrated indicator is defined by the following formula (Vorobyov, et. al. 2013):

$$I_{ES} = k_1 \pm k_2 \pm k_3 \pm ... \pm k_n \qquad (3)$$

where k1 – kn – are the cumulative indices for different groups.

To assess economic security we will use the financial statements of PAO Severstal. We assess economic security, using data from the quarterly reports of the concerned enterprise. Table 2 presents the calculations of financial ratios, characterizing economic security of the enterprise analyzed. Calculations of reduced ratios are presented in Table 3.

Table 4 presents calculations of integrated indicator of economic security of PAO Severstal.

The statutory value for the financial status group is 5, because this group consists of 5 ratios. As we see, the integrated indicator in each of the analyzed periods exceeds the statutory value. The highest value was obtained in the III quarter of 2014. The share of receivables in assets, which is much less than the set statutory value in virtually each of the analyzed periods, provides greatest effect on this ratio.

The statutory value for the liquidity and financial responsibility group is 4. The integrated indicator exceeds the statutory value only in the first quarter of 2015, while in other periods this indicator is less than statutory value. The enterprise inefficiently uses its financial resources. This is evidenced by the absolute liquidity ratio, whose values are significantly above the statutory values for this coefficient.

The statutory value for the financial independence group is 3. The integrated indicator in this group for most of the analyzed periods is within the range of 1.5-2.2. At that, in the I quarter of 2016, the integrated indicator for this group exceeds the value obtained in the IV quarter of

2015. In our view, the situation is non-critical and is explained by the fact that the company pays dividends that reduces the amount of owners' equity.

The statutory value for the financial soundness group is also equal to 3. It should be noted that in I quarter of 2016, the cumulative index for this group is less than 0. The resulting value indicates that in this period, the portion of non-current company assets was formed at the expense of short-term borrowings. Based on this fact, all the financial soundness ratios calculated in this period, were negative. We should also pay attention to the fact that the cumulative index of financial soundness in 2014 is greater than the statutory value, while in 2015, with the exception of the first quarter, it is less than statutory value. Such dynamics of the cumulative index of financial soundness is due to the fact that PAO Severstal in 2015 started to pay its debt to the founders that led to the reduction of owner’s capital, and this in turn has reduced the financial stability of the concerned enterprise.

Table 2. Calculation of indicators characterizing economic security of PAO Severstal

Indicators	2014				2015				2016
	I Q	II Q	III Q	IV Q	I Q	II Q	III Q	IV Q	I Q
The ratios of financial status									
1. The share of circulating assets in the property	0.1762	0.1758	0.3205	0.3995	0.4183	0.3872	0.4036	0.4185	0.3745
2. The share of receivables in assets	0.0559	0.0643	0.0485	0.0850	0.1049	0.0659	0.0622	0.0791	0.0589
3. The mobile assets ratio	0.2139	0.2133	0.4717	0.6653	0.7190	0.6317	0.6766	0.7196	0.5986
4. The growth rate of business property	0.9785	0.9915	1.2005	1.0039	1.0106	0.9547	1.0487	1.0198	1.0168
5. The growth rate of current assets	0.9197	0.9891	2.1888	1.2514	1.0581	0.8837	1.0931	1.0575	0.9099
The ratios of liquidity and solvency									
1. Absolute liquidity ratio	0.3008	0.3985	1.4636	1.2168	1.7437	0.8110	0.7248	0.6842	0.6379
2. The refined (intermediate) liquidity ratio	0.5980	0.8716	1.7698	1.4487	2.1612	1.0039	0.8712	0.7868	0.7591
3. The current liquidity ratio	1.0610	1.4176	2.1797	1.9740	2.9698	1.2794	1.0738	1.0631	0.9700

4. The solvency ratio	0.0610	0.4176	1.1797	0.9740	1.9698	0.2794	0.0738	0.0631	-0.0300
The ratios of financial independence									
1. Equity to total assets	0.4650	0.4970	0.4166	0.2678	0.3443	0.3415	0.2878	0.2529	0.2856
2. Financing ratio	0.8693	0.9879	0.7141	0.3658	0.5251	0.5186	0.4042	0.3385	0.3998
3. Stable funding sources concentration ratio	0.8339	0.8760	0.8530	0.7976	0.8592	0.6974	0.6242	0.6064	0.6140
The ratios of financial soundness									
1. The growth rate of invested working capital	61.8877	5.0657	4.0216	1.1409	1.4224	0.2910	0.3438	0.9135	-0.4735
2. The collateralization ratio of current assets by invested capital	0.0575	0.2946	0.5412	0.4934	0.6633	0.2184	0.0687	0.0593	-0.0309
3. The maneuverability of the working capital	5.9367	1.0184	0.2872	0.3162	0.2164	0.7812	2.2065	2.5419	-5.3033
The ratios of business activity									
1. The asset turnover ratio	0.1334	0.2855	0.3669	0.4996	0.1536	0.3083	0.4526	0.5774	0.1260
2. The current assets turnover ratio	0.7568	1.6240	1.1447	1.2506	0.3673	0.7964	1.1214	1.3798	0.3364
3. The inventory turnover ratio	1.7774	4.2365	5.5666	5.8739	1.5790	3.0356	4.8185	6.0796	1.5418
4. The receivable turnover accounts ratio	2.3847	4.4394	7.5653	5.8754	1.4649	4.6816	7.2791	7.2975	2.1399
5. The equity capital turnover ratio	0.2868	0.5744	0.8806	1.8655	0.4462	0.9029	1.5723	2.2832	0.4410
6. The payable									

turnover ratio	1.5321	2.5713	3.5684	4.5488	1.3928	3.0195	3.0385	5.2285	1.4752
7. The duration of the production cycle	88.4	41.5	28.1	30.6	118.4	48.9	31.0	27.1	100.4
8. The duration of the financial cycle	29.6	6.5	2.8	10.9	53.8	19.1	1.4	9.9	39.4
Profitability performance profile (ROI)									
Return on equity									
1. Return on assets (ROA)	-0.0282	0.0203	0.0268	-0.0806	0.0888	0.1347	0.1044	0.0917	0.0446
2. Return of equity (ROE)	-0.0607	0.0408	0.0643	-0.3011	0.2578	0.3946	0.3627	0.3627	0.1561
3. Utilization efficiency of circulating assets	-0.1601	0.1153	0.0835	-0.2019	0.2122	0.3480	0.2587	0.2192	0.1190
Profitability of sales									
4. Gross sales effectiveness	0.1981	0.2175	0.2441	0.2673	0.3829	0.3496	0.3487	0.3354	0.2493
5. Sales operating performance	0.0942	0.1460	0.2016	0.2269	0.2940	0.2169	0.2586	0.1863	0.1437
6. The net impact of sales	-0.1729	0.2746	0.0503	-0.3696	0.5161	0.2160	-0.1146	-0.0486	0.2929

Source: compiled by the authors based on (Vorobyov and Blazhevich 2010; Dudin,et. al. 2016a)

Table 3. Recalculation of ratios into comparable values

Indicators	2014				2015				2016
	I Q	II Q	III Q	IV Q	I Q	II Q	III Q	IV Q	I Q
The ratios of financial status									
1. The share of circulating assets in the property	0.3524	0.3516	0.6410	0.7990	0.8365	0.7743	0.8071	0.8369	0.7489

2. The share of receivables in assets	3.5762	3.1102	4.1241	2.3519	1.9071	3.0369	3.2169	2.5276	3.3977
3. The mobile assets ratio	0.2139	0.2133	0.4717	0.6653	0.7190	0.6317	0.6766	0.7196	0.5986
4. The growth rate of business property	0.9546	0.9673	1.1712	0.9794	0.9860	0.9314	1.0231	0.9949	0.9920
5. The growth rate of current assets	0.9083	0.9769	2.1618	1.2359	1.0451	0.8728	1.0796	1.0444	0.8987
Cumulative index of the group	6.0055	5.6193	8.5697	6.0315	5.4937	6.2472	6.8032	6.1235	6.6360
The ratios of liquidity and solvency									
1. Absolute liquidity ratio	0.9972	0.7529	0.2050	0.2465	0.1720	0.3699	0.4139	0.4385	0.4703
2. The refined (intermediate) liquidity ratio	0.8542	0.9178	0.4520	0.5522	0.3702	0.7969	0.9183	1.0000	1.0000
3. The current liquidity ratio	1.0000	1.0000	0.9176	1.0000	0.6734	1.0000	1.0000	1.0000	0.9700
4. The solvency ratio	0.1220	0.8351	2.3593	1.9480	3.9396	0.5589	0.1475	0.1262	-0.0599
Cumulative index of the group	2.9735	3.5058	3.9339	3.7467	5.1553	2.7257	2.4797	2.5646	2.3804
The ratios of financial independence									
1. Equity to total assets	0.9301	0.9939	0.8332	0.5357	0.6886	0.6830	0.5757	0.5058	0.5712
2. Financing ratio	0.8693	0.9879	0.7141	0.3658	0.5251	0.5186	0.4042	0.3385	0.3998
3. Stable funding sources concentration ratio	0.9811	1.0306	1.0035	0.9384	1.0108	0.8205	0.7343	0.7134	0.7223

Cumulative index of the group	2.7805	3.0124	2.5508	1.8398	2.2245	2.0220	1.7142	1.5577	1.6933
The ratios of financial soundness									
1. The growth rate of invested working capital	6.0000	4.9421	3.9235	1.1130	1.3877	0.2839	0.3354	0.8912	-0.4620
2. The collateralization ratio of current assets by invested capital	0.2876	1.4728	2.7061	2.4671	3.3164	1.0921	0.3435	0.2967	-0.1544
3. The maneuverability of the working capital	0.0505	0.2946	1.0444	0.9488	1.3863	0.3840	0.1360	0.1180	-0.0566
Cumulative index of the group	6.3381	6.7095	7.6740	4.5289	6.0904	1.7600	0.8149	1.3059	-0.6730
The ratios of business activity									
1. The asset turnover ratio	0.5334	1.1419	1.4675	1.9985	0.6145	1.2333	1.8102	2.3097	0.5038
2. The current assets turnover ratio	1.5136	3.2480	2.2895	2.5013	0.7346	1.5927	2.2429	2.7597	0.6727
3. The inventory turnover ratio	1.7774	4.2365	5.5666	5.8739	1.5790	3.0356	4.8185	6.0796	1.5418
4. The receivable turnover accounts ratio	0.7949	1.4798	2.5218	1.9585	0.4883	1.5605	2.4264	2.4325	0.7133
5. The equity capital turnover ratio	0.5735	1.1489	1.7613	3.7309	0.8924	1.8058	3.1445	4.5663	0.8820
6. The payable turnover ratio	0.5107	0.8571	1.1895	1.5163	0.4643	1.0065	1.0128	1.7428	0.4917
7. The duration									

of the production cycle	0.6789	1.4452	2.1379	1.9582	0.5066	1.2277	1.9329	2.2110	0.5974
8. The duration of the financial cycle	1.5184	6.9064	15.8298	4.1457	0.8362	2.3602	31.6431	4.5348	1.1414
Cumulative index of the group	7.9009	20.4637	32.7638	23.6832	6.1159	13.8222	49.0313	26.6364	6.5442
Profitability performance profile (ROI)									
Return on equity									
1. Return on assets (ROA)	-1.6118	1.1581	1.5296	-4.6081	5.0728	7.6992	5.9661	5.2419	2.5472
2. Return of equity (ROE)	-2.4262	1.6313	2.5701	-12.0437	10.3135	15.7824	14.5087	14.5085	6.2428
3. Utilization efficiency of circulating assets	-6.4028	4.6118	3.3409	-8.0744	8.4895	13.9204	10.3487	8.7683	4.7615
Profitability of sales									
4. Gross sales effectiveness	0.9906	1.0874	1.2203	1.3365	1.9146	1.7479	1.7436	1.6769	1.2467
5. Sales operating performance	0.9422	1.4601	2.0159	2.2687	2.9395	2.1691	2.5860	1.8630	1.4375
6. The net impact of sales	-3.4587	5.4920	1.0069	-7.3916	10.3216	4.3199	-2.2913	-0.9720	5.8583
Cumulative index of the group	-11.9668	15.4409	11.6837	-28.5125	39.0516	45.6389	32.8618	31.0864	22.0939

Source: compiled by the authors

Table 4. The calculation of the integrated index of economic security of PAO Severstal

Name of indicator	2014				2015				2016	Statutory value

	I Q	II Q	III Q	IV Q	I Q	II Q	III Q	IV Q	I Q	
Cumulative index of financial status	6.0055	5.6193	8.5697	6.0315	5.4937	6.2472	6.8032	6.1235	6.6360	5
Cumulative index of liquidity and solvency	2.9735	3.5058	3.9339	3.7467	5.1553	2.7257	2.4797	2.5646	2.3804	4
Cumulative index of financial soundness	6.3381	6.7095	7.6740	4.5289	6.0904	1.7600	0.8149	1.3059	-0.6730	3
Cumulative index of financial independence	2.7805	3.0124	2.5508	1.8398	2.2245	2.0220	1.7142	1.5577	1.6933	3
Cumulative index of business activity	7.9009	20.4637	32.7638	23.6832	6.1159	13.8222	49.0313	26.6364	6.5442	8
Cumulative index of profitability	-11.9668	15.4409	11.6837	-28.5125	39.0516	45.6389	32.8618	31.0864	22.0939	6
Integrated indicator of economic security	14.0317	54.7517	67.1759	11.3177	64.1313	72.2159	93.7051	69.2747	38.6749	29

Source: calculated by the authors

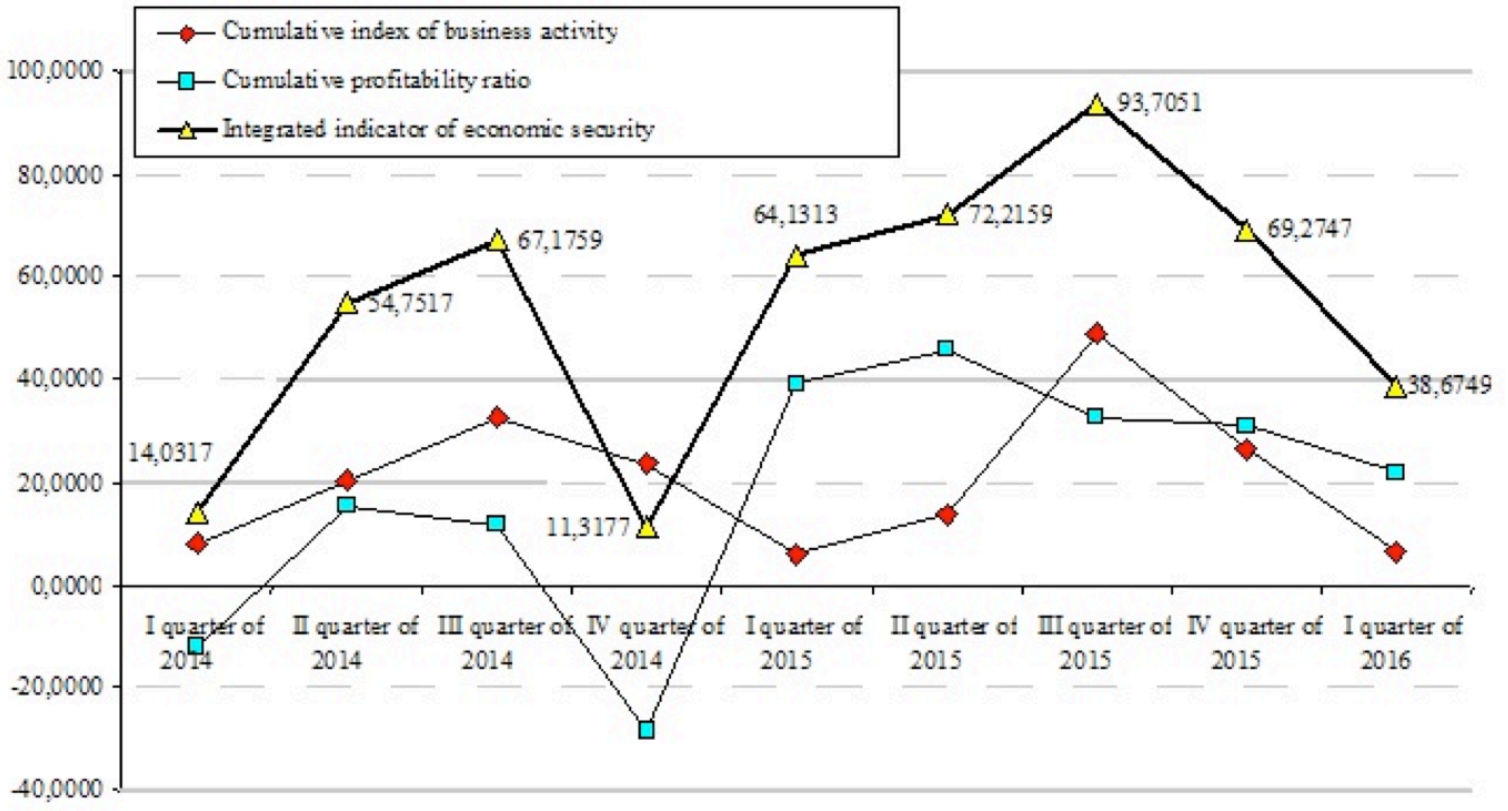
The statutory value of the cumulative index of business activity is 8. This group includes the largest number of indicators. Fluctuations in cumulative index of business activity are quite significant: from 6.5442 in the I quarter of 2016 to 49.0313 in the III quarter of 2015. The cumulative indicator of business activity is influenced most largely by inventory turnover ratio and the duration of the financial cycle. A high level of the latter indicator evidences financial literacy of PAO Severstal top management.

The statutory value of the cumulative profitability ratio is equal to 6. This indicator has the strongest fluctuations among all calculated ones that depend on the received financial result. It should be noted that in the I and IV quarters of 2015, the analyzed enterprise has incurred losses. This led to the fact that in the reporting periods, the cumulative profitability ratio was negative.

The statutory value of the integrated indicator of economic security is 29, based on the number of coefficients included in all groups that affect the economic security of PAO Severstal. The integrated indicator of economic security is influenced most strongly by the cumulative

profitability ratio, and indicates that the level of economic security at the enterprise in general is quite satisfactory. Although, losses incurred in the I and IV quarters of 2015, have led to the fact that in these periods integrated indicator of economic security was below the permissible level.

In general we can note that the integrated indicator of economic security at PAO Severstal depends to a greater extent on the cumulative index of business activity and profitability ratio that is clearly shown in Fig. 1.



Source: compiled by the authors (The official website of the Public Joint Stock Company "Severstal)

Fig. 1. The dynamics of the integrated indicator of economic security and its components at PAO Severstal in 2014-2016.

There are various methods of graphical representation of the economic security level at the enterprise. One of these methods is a polygon of economic security. Though, it is not reasonable to construct such polygon based on complete set of data since it will be unreadable. Besides, there are several conditions that must be followed: all the data must be reduced to values varying within the range of 0-1 and having the same sign.

Construct the polygon of economic security based on data of 2015. To do this, we should choose the largest value among all cumulative indicators for 2015 (for each line separately) and then each of them divide by chosen maximum value. The values obtained are given in Table 5.

Table 5. The source data for constructing the polygon of economic security

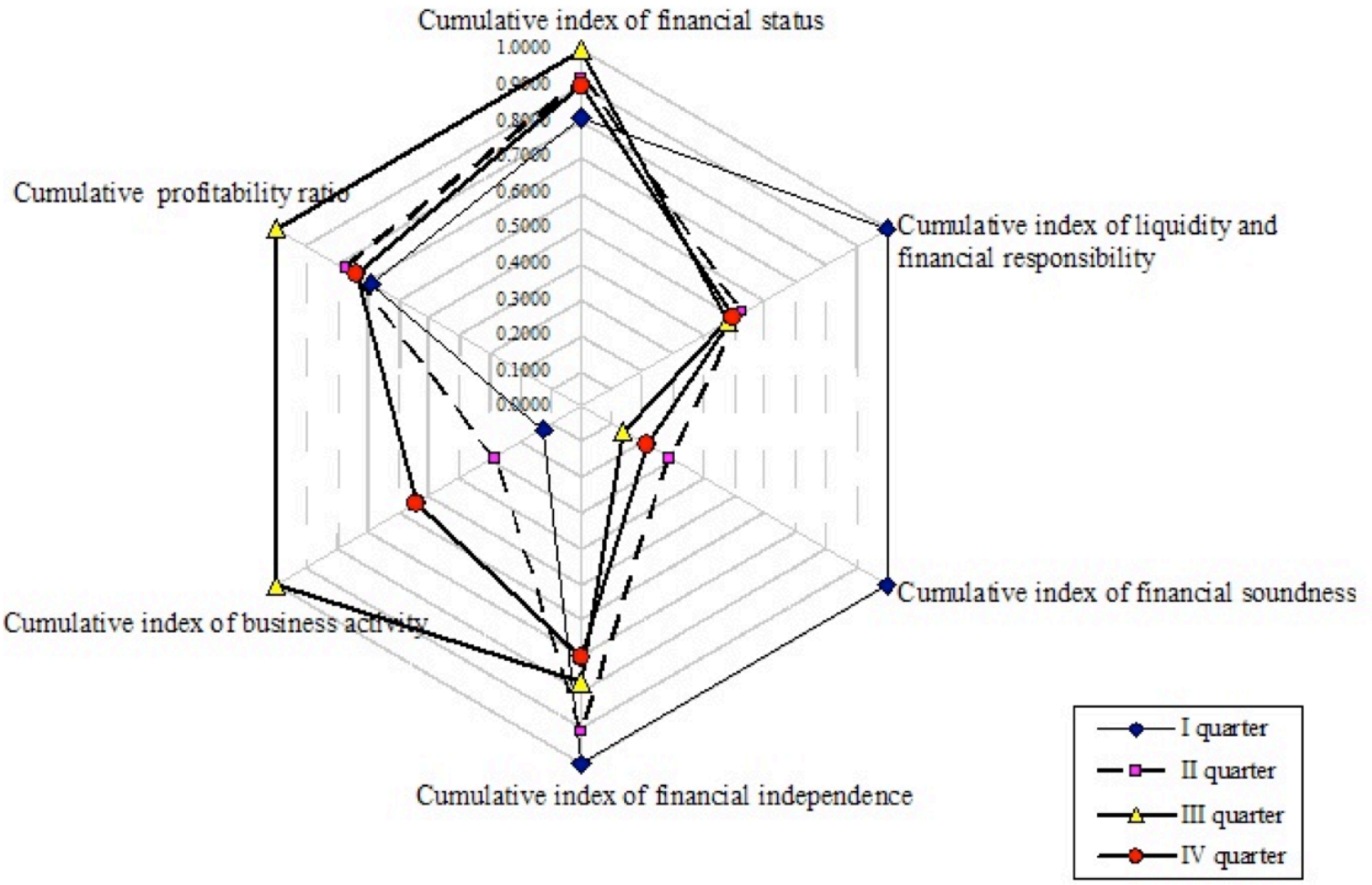
Name of cumulative indicator	I Q 2015	II Q 2015	III Q 2015	IV Q 2015
Cumulative index of financial status	0.8075	0.9183	1.0000	0.9001
Cumulative index of liquidity and financial responsibility	1.0000	0.5287	0.4810	0.4975
Cumulative index of financial soundness	1.0000	0.2890	0.1338	0.2144
Cumulative index of financial independence	1.0000	0.9090	0.7706	0.7003
Cumulative index of business activity	0.1247	0.2819	1.0000	0.5433

Cumulative profitability ratio	0.6844	0.7707	1.0000	0.7393

Source: compiled by the authors

4. Discussion

Figure 2 shows the constructed polygon of economic security.



Source: constructed by the authors

Fig. 2. Graphical representation of the economic security level at PAO Severstal in 2015.

In Fig. 2 we can determine visually that the highest level of economic security of the enterprise was observed in the first and third quarters of 2015.

To determine the accuracy of the result we calculate the area of a financial security polygon for each year according to the formula:

$$S = \frac{1}{2} \times \sin\frac{360}{n} \times (k_1 \times k_2 + k_2 \times k_3 + k_3 \times k_4 + \ldots + k_{n-1} \times k_n + k_n \times k_1), \qquad (4)$$

where S – is the area of a polygon of a particular enterprise; n – is the number of cumulative induces, k – is the cumulative induces for groups (Burkaltseva 2012).

$$S_{2015\_I} = \frac{1}{2} \times \sin\frac{360}{6} \times (0{,}8075 \times 1{,}0000 + 1{,}0000 \times 1{,}0000 + 1{,}0000 \times 1{,}0000 + 1{,}0000 \times 0{,}1247 + 0{,}1247 \times 0{,}6844 + 0{,}6844 \times 0{,}8075) = 1{,}5459$$

$$S_{2015\_II} = \frac{1}{2} \times \sin\frac{360}{6} \times (0{,}9183 \times 0{,}5287 + 0{,}5287 \times 0{,}2890 + 0{,}2890 \times 0{,}9090 + 0{,}9090 \times 0{,}2819 + 0{,}2819 \times 0{,}7707 + 0{,}7707 \times 0{,}9183) = 0{,}9016$$

$$S_{2015\_III} = \frac{1}{2} \times \sin\frac{360}{6} \times (1{,}0000 \times 0{,}4810 + 0{,}4810 \times 0{,}1338 + 0{,}1338 \times 0{,}7706 + 0{,}7706 \times 1{,}0000 + 1{,}0000 \times 1{,}0000 + 1{,}0000 \times 1{,}0000) = 1{,}4805$$

$$S_{2015\_IV} = \frac{1}{2} \times \sin\frac{360}{6} \times (0{,}9001 \times 0{,}4975 + 0{,}4975 \times 0{,}2144 + 0{,}2144 \times 0{,}7003 + 0{,}7033 \times 0{,}5433 + 0{,}5433 \times 0{,}7393 + 0{,}7393 \times 0{,}9001) = 0{,}9318$$

The calculated areas showed that the best level of economic security was received in the first quarter of 2015, while slightly lower value corresponds to the third quarter of 2015. The disadvantage of this method is that it does not take into account statutory values, i.e. we can identify the best and worst levels, while cannot compare them with the statutory value.

We can slightly upgrade the integrated indicator of economic security, providing each cumulative index with weighting coefficient. We get the following formula:

$$I_{ЭБ} = p_1 \times k_1 \pm p_2 \times k_2 \pm p_3 \times k_3 \pm ... \pm p_n \times k_n \quad (5)$$

where p1 – pn – are the significances of cumulative indices;

k1 – kn – are the cumulative indices of the groups.

In our opinion, the following weighting coefficients should be assigned to groups of cumulative indicators characterizing the level of economic security:

- cumulative index of financial status – 5%;
- cumulative index of liquidity and financial responsibility – 15%;
- cumulative index of financial soundness – 15%;
- cumulative index of financial independence– 5%;
- cumulative index of business activity – 35%;
- cumulative profitability ratio – 25%;
- total – 100%.

The weighting coefficients depend on the quality and quantity of groups of factors involved in the calculation. In this case, the statutory value of the integral index of economic security will be 5.75 (5 ´ 0.05 + 4 ´ 0.15 + 3 ´ 0.15 + 3 ´ 0.05 + 8 ´ 0.35 + 6 ´ 0.25).

Calculate the integrated indicator of economic security taking into account the weighting coefficients of the cumulative indices:

$$I_{ES\_2014\_I} = 0{,}3003 + 0{,}4460 + 0{,}9507 + 0{,}1390 + 2{,}7653 - 2{,}9917 = 1{,}6097$$
$$I_{ES\_2014\_II} = 0{,}2810 + 0{,}5259 + 1{,}0064 + 0{,}1506 + 7{,}1623 + 3{,}8602 = 12{,}9864$$
$$I_{ES\_2014\_III} = 0{,}4285 + 0{,}5901 + 1{,}1511 + 0{,}1275 + 11{,}4673 + 2{,}9209 = 16{,}6855$$
$$I_{ES\_2014\_IV} = 0{,}3016 + 0{,}5620 + 0{,}6793 + 0{,}0920 + 8{,}2891 - 7{,}1281 = 2{,}7959$$
$$I_{ES\_2015\_I} = 0{,}2747 + 0{,}7733 + 0{,}9136 + 0{,}1112 + 2{,}1406 + 9{,}7629 = 13{,}9762$$
$$I_{ES\_2015\_II} = 0{,}3124 + 0{,}4089 + 0{,}2640 + 0{,}1011 + 4{,}8378 + 11{,}4097 = 17{,}3338$$
$$I_{ES\_2015\_III} = 0{,}3402 + 0{,}3720 + 0{,}1222 + 0{,}0857 + 17{,}1610 + 8{,}2155 = 26{,}2965$$
$$I_{ES\_2015\_IV} = 0{,}3062 + 0{,}3847 + 0{,}1959 + 0{,}0779 + 9{,}3227 + 7{,}7716 = 18{,}0590$$
$$I_{ES\_2016\_I} = 0{,}3318 + 0{,}3571 - 0{,}1009 + 0{,}0847 + 2{,}2905 + 5{,}5235 = 8{,}4865$$

Table 6 presents a comparison of calculations of the integrated indicator of economic security with and without use of weighting coefficients.

Table 6. The comparison of the integrated indicator of economic security calculated with and without use of weighting coefficients

Periods	Calculation methods			
	Integrated indicator of economic security without the use of weighting coefficient		Integrated indicator of economic security using weighting coefficient	
	points	rank	points	rank

IES_2014_I	14.0317	8	1.6097	9
IES_2014_II	54.7517	6	12.9864	6
IES_2014_III	67.1759	4	16.6855	4
IES_2014_IV	11.3177	9	2.7959	8
IES_2015_I	64.1313	5	13.9762	5
IES_2015_II	72.2159	2	17.3338	3
IES_2015_III	93.7051	1	26.2965	1
IES_2015_IV	69.2747	3	18.0590	2
IES_2016_I	38.6749	7	8.4865	7

Source: compiled by the authors

Table 6 shows that the weighting coefficients do not have a significant effect on the calculation of integrated indicator of economic security. The best values indicator were defined for the III, II and IV quarters of 2015 without taking into account the weighting coefficients of cumulative indicators, and for III, IV and II quarters of 2015 – with the use of weighting coefficients. The worst level of economic security was noted in the I and IV quarters without taking into account the weighting coefficient. While, if used, these quarters swap places. Comparing them with statutory values, we see that the obtained data are below the statutory values of the integrated indicator of economic security, no matter whether weighting coefficients were used or not.

5. Conclusions

The calculation of the integrated indicator of economic security of PAO Severstal has shown that the weighting coefficients do not have significant effect on the integrated indicator of economic security. Its best values were defined for the III, II and IV quarters of 2015 without taking into account the weighting coefficients of cumulative indicators, and for III, IV and II quarters of 2015 – while using weighting coefficients. The worst level of economic security was noted in the I and IV quarters without taking into account the weighting coefficient. While, if used, these quarters swap places. Comparing them with statutory values, we see that the obtained data are below the statutory values of the integrated indicator of economic security, no matter whether weighting coefficients were used or not.

This article outlines the basis of formation of socio-economic indicators system providing economic security of a business through application in the future of neural networks as the primary element of economic system to create investment platforms, develop and support the next generation system for regulation of production. This is done by systematizing indicators, using cognitive technologies and decomposition of the factor space, justifying the fundamental factors in real time with due account for the effect of integration, globalization and modern challenges that create a new round of risks, threats, and hazards, poorly understood to date.

Further research should be directed at improving the model to identify the class of business economic security based on the hybrid fuzzy neural networks, which will allow obtaining a more precise assessments of economic security class in the current and future periods, accurately and flexibly respond to the features of the new data based on generalization techniques.

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