Determination Of The Critical Risk Zone For The Indicator Of Foreign Trade Import Coverage By The Export Of Goods And Services Subject To Its Normal Distribution

Fokina-Mezentseva Katerina, Melnyk Tetiana, Diatlova Valentyna, Buhas Vasyl, Shatska Zorina

Abstrac: Today, there is a need for new scientific and methodological approaches to determine the effectiveness of foreign trade activity of the state, which will allow not only careful analysis and forecasting of export-import operations of the country, but also at the same time make informed, well-grounded management decisions. The calculated values of the cumulative frequency and some numerical characteristics for the empirical and statistical series of the world index of import coverage by export for Ukraine for the period 1996-2017 are presented. Confidence intervals were found for: general mean, variance, root mean square deviation; the Pearson test of the normal law of distribution of the world export coverage indicator for Ukraine for the period 1996-2017 was tested. The same hypothesis was also tested using the three sigma rule. Areas of permissible, critical and catastrophic risk by the rule of three sigmas are presented, which makes it possible to analyze the belonging to these areas of the world index of coverage of imports by export for Ukraine, which is distributed according to the normal law of distribution. It is substantiated that after 2013 the global indicator for Ukraine of import cover by export has entered the area of critical risk and will be in it with a forecast until 2019, and then may enter the area of catastrophic risk. It is proved that for the future development of foreign trade Ukraine needs strategic transformations in the national foreign trade policy. The main direction of its development should be the use of instruments for increasing the export volumes of goods and services and reducing the country's import dependence, in particular on goods. At the same time, the structure of export and import should be optimized with a focus on reducing the volume of the latter.

Index Terms: Export potential, import dependency, empirical frequency range, numerical characteristics, acceptable risk, critical risk, catastrophic risk.

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1   INTRODUCTION

Today**,** the formation of the process of Integration of national economies into the global economic system continues, which is conditioned by the growth of trade between countries [1]. In today's global economic system, countries exchange not only finished products but also intermediate resources. This creates a complex network of economic interactions that spans the world [1]. We emphasize that the global economy is characterized by stable economic growth, which is accompanied by growth in world trade. The indicator imports coverage ratios by export for goods and services measures the degree to which foreign trade is balanced. Based on the value of exports and imports of goods and services, the coefficient of export coverage of imports is calculated, which leads to a conclusion about the balance of foreign trade of Ukraine (negative or positive). If the imports coverage ratios by export is greater than 1, then the foreign trade balance is positive, if less than 1, then it is negative. For example, in 2017, the imports coverage ratios by export of services was 1.96, so the corresponding balance is positive. Or, in 2017, the

coefficient for the Goods and Services group was 0.95, which means that the value of imports over exports, which is a negative foreign trade balance, is exceeded. It can be noted that global development trends and dynamics of integration processes pose new problems for Ukraine that require a detailed study of approaches to their solution. An urgent task is the statistical study of the index import coverage by the export in Ukraine as the main indicator of foreign trade activity, which will allow determining the zone of critical risk of this foreign trade indicator for Ukraine.

2 LITERARY REVIEW

Scientists argue that there is a correlation between economic growth and trade, with higher rates of trade growth being observed in countries with corresponding GDP growth rates [2, 3]. Thus, trade does not indirectly affect GDP per capita and macroeconomic productivity (GDP per worker) in the long run. Trade liberalization, which improves economic efficiency, is dedicated to labor [4], which presents data that emerges from different political and economic contexts and includes both micro- and macro-efficiency measures.In the article [5], the authors in Modeling the Economic Security of Regional External Trade Flows prove that for some regions of Ukraine it is possible to construct two-dimensional normal distribution laws and to define regions of threshold values. Please note that the list of countries that cooperate with Ukraine in the context of export-import relations is quite large. But there are a number of countries that stand out more clearly over the last period against the background of others, and vice versa. This situation can be safely attributed to foreign trade in both goods and services [6]. Scientific papers [7, 8, 9] show that Ukraine has both export potential and import dependence in certain categories of goods and services. With regard to export-import operations on goods, the situation is such that the value of imports in Ukraine exceeds the volume of exports; in terms of

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- *Fokina-Mezentseva Katerina, Department of Foreign Economic Activity of Enterprise, Kyiv National University of Trade and Economics, Kyiv, Ukraine. Email: fok.mezentseva@gmail.com*
- *Melnyk Tetiana, Department of Foreign Economic Activity of Enterprise, Kyiv National University of Trade and Economics, Kyiv, Ukraine. Email: t.melnyk@knute.edu.ua*
- *Diatlova Valentyna, Department of management of foreign economic and innovative activity Donetsk State University of Management of Ministry of Education and Science of Ukraine (Mariupol, Ukraine). Email: dyatlovi@inbox.ru*
- *Buhas Vasyl, Department of Management, Kyiv National University of Technologies and Design, Kyiv, Ukraine. Email: buhas0203@gmail.com*
- *Shatska Zorina, Department of Business Economics and Tourism, Kyiv National University of Technologies and Design, Kiev, Ukraine.Email: shatskaya@ukr.net*

4843

services, exports are higher than imports [10]. The calculation of the foreign trade balance and the coefficients import coverage by the export shows that there are differences between the value of exports and imports of both goods and services [10]. Some regions have a significant impact on the formation of foreign trade indicators of Ukraine, while others - on the contrary [11]. However, today there is a need for new scientific and methodological approaches to determine the effectiveness of foreign trade activity of the state, which will allow not only careful analysis and forecasting of export-import operations of the country, but at the same time make informed, well-grounded management decisions. The analysis uses general scientific methods (analysis and synthesis, comparison), methods of probabilistic-statistical analysis, in particular, testing of statistical hypotheses regarding the laws of probability distribution. The information base of the analysis is the data of the State Statistics Committee of Ukraine.

3 RESULTS

Ukraine's foreign trade activity is characterized by operations on trade in goods and services. This activity is conditioned by the partnership of trading participants. The foreign trade balance of Ukraine contains information on exports and imports, geographical representation of goods and services of Ukrainian production in foreign markets, geographical and commodity structure of imports to Ukraine and is calculated according to the results of the reporting period. It should be noted that foreign trade activity is an important component of commodity circulation, foreign economic activity, economic and foreign security of the state. From all known indicators of export-import operations of the country, we can distinguish the index of coverage of imports by exports, the dynamics of which will be analyzed in terms of exports and imports of goods and services, which Ukraine conducts in foreign trade relations with countries around the world. Table 1 presents the dynamics of Ukraine's world exports, Ukraine's world imports and import coverage by the export of Ukraine for the period 1996-2017.

TABLE 1
DYNAMICS OF WORLD EXPORTS, IMPORTS, AND IMPORTS COVERAGE BY EXPORTS   TO UKRAINE FOR 1996-2017

x_i	Year	World Exports	World Imports	y_i
1	1996	14400243	17602879,49	0,818062
2	1997	14217475	17124859,9	0,830224
3	1998	12637410	14675974,14	0,861095
4	1999	11581572	11846114,3	0,977668
5	2000	14572550	13956027,19	1,044176
6	2001	16264734	15775092,66	1,031039
7	2002	17927432	16975884,13	1,056053
8	2003	23066846	23020437,66	1,002016
9	2004	32666132	28996784,33	1,126543
10	2005	34227974	36121997,44	0,947566
11	2006	38367609	45021620,6	0,852204
12	2007	49294390	60600580,94	0,813431
13	2008	66952306	85448380,85	0,783541
14	2009	39695648	45412943,89	0,874104
15	2010	51430286	60737134,59	0,846768
16	2011	60737135	82607537,26	0,735249
17	2012	68694495	84656666,98	0,811448
18	2013	63320469	76986012,5	0,822493
19	2014	53913302	54381409,09	0,991392
20	2015	38127040	37516153,22	1,016283
21	2016	36361032	39249626,35	0,926405

Figure 1 presents (according to the calculations of Table 1) the dynamics of the coverage of imports by export of foreign trade relations of Ukraine with all countries of the world for 1996-2017.
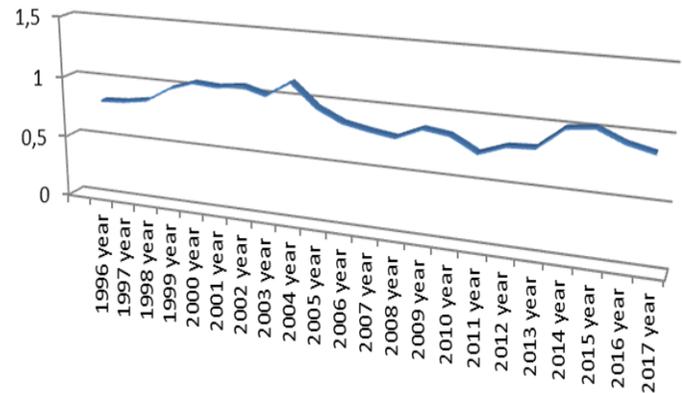

***Fig. 1**. Dynamics of coverage of import by export of foreign trade relations of Ukraine with all countries of the world for 1996-2017*

As can be seen from Figure 1, there is a damping of this indicator near the value 1, which is the threshold of the country's foreign trade security. Table 2 presents the calculated values of the cumulative frequency and some numerical characteristics for the empirical and statistical series of the world Imports coverage by Exports indicator for Ukraine for the period 1996-2017.

TABLE 2
ESTIMATED CUMULATIVE FREQUENCY VALUES AND SOME NUMERICAL CHARACTERISTICS FOR IMPORTS COVERAGE BY EXPORTS

x_i	y_i	$x_i \cdot y_i$	Accumulated frequency	$\left|x_i - \overline{x}\right| \cdot y_i$	$\left|x_i - \overline{x}\right|^2 \cdot y_i$	$\dfrac{y_i}{\sum y_i}$
1	0.81806176	0.818	0.818061766	8.485	88.008	0.0408
2	0.83022431	1.66	1.64828608	7.781	72.925	0.0414
3	0.86109516	2.583	2.50938124	7.209	60.357	0.043
4	0.97766844	3.911	3.487049681	7.208	53.135	0.0488
5	1.04417610	5.221	4.531225788	6.654	42.398	0.0521
6	1.03103891	6.186	5.562264698	5.539	29.756	0.0514
7	1.05605293	7.392	6.618317631	4.617	20.187	0.0527
8	1.00201594	8.016	7.620333574	3.379	11.394	0.05
9	1.12654326	10.139	8.746876834	2.672	6.339	0.0562
10	0.94756592	9.476	9.69444276	1.3	1.784	0.0473
11	0.85220409	9.374	10.546646852	0.317	0.118	0.0425
12	0.81343097	9.761	11.360077828	0.511	0.321	0.0406
13	0.78354096	10.186	12.143618789	1.275	2.076	0.0391
14	0.87410425	12.237	13.017723046	2.297	6.036	0.0436
15	0.84676838	12.702	13.864491435	3.072	11.145	0.0422
16	0.73524930	11.764	14.599740743	3.403	15.747	0.0367
17	0.81144814	13.795	15.411188889	4.567	25.701	0.0405
18	0.82249316	14.805	16.23368205	5.451	36.131	0.041
19	0.99139215	18.836	17.225074206	7.562	57.683	0.0495
20	1.01628328	20.326	18.241357494	8.768	75.652	0.0507
21	0.92640455	19.454	19.167762045	8.919	85.873	0.0462
22	0.87842096	19.325	20.046183013	9.336	99.218	0.0438
∑	20.0461830	227.968		110.323	801.985	1

On the basis of Table 2 we construct a polygon of empirical frequencies, which is presented in Fig.1.
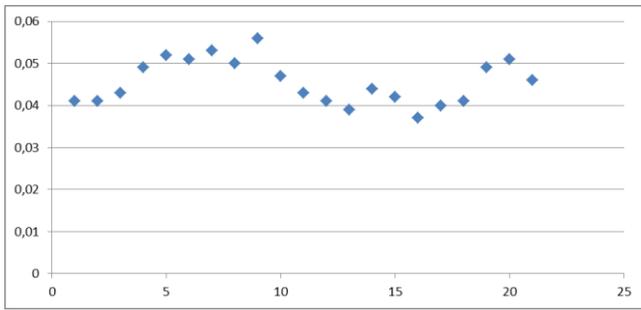
Fig. 1. The range of empirical frequencies of the distribution of the statistical series of the world index of Imports coverage by Exports to Ukraine for the period 1996-2017.

Using the data of Table 1- 2, we find the numerical characteristics of the statistical series of the world index of Imports coverage by Exports in the form:

1. Weighted average (sample average)

$$\bar{x} = \frac{\sum x_i y_i}{y_i} = \frac{227,968}{20.0461} = 11,37 .$$

2. Mean linear deviation

$$d = \frac{\sum |x_i - \bar{x}| y_i}{\sum y_i} = \frac{110,323}{21,0461} = 5,5$$

3. Me=12, Mo=9,   the range of variation R=21.
4. Dispersion

$$D = \frac{\sum (x_i - \bar{x})^2 y_i}{\sum y_i} = \frac{801,985}{21,0461} = 40,007 .$$

5. Mean square deviation

$$\sigma = \sqrt{D} = \sqrt{40,007} = 6,325 .$$

6. The coefficient of variation

$$V = \frac{\sigma}{x} = 0,5562 .$$

7. Unbiased variance estimate

$$S^2 = 42,107 .$$

8. Evaluation standard deviation

$$s = \sqrt{S^2} = \sqrt{42,107} = 6,489 .$$

9. Linear coefficient of variation

$$Kd = \frac{d}{x} = 0,4836 .$$

10. Oscillation coefficient

$$Kr = \frac{r}{x} = 1,8466 .$$

11. Asymmetry

$$As = -0,0834$$

(the presence of right-sided asymmetry).

12. Excess

$$Ex = -1,22$$

(flat distribution).

Interval estimation of the center of the aggregate as a confidence interval for the general mean is found as the interval: (11.37 - 3.02; 11.37 + 3.02) = (8.35; 14.4) Therefore, with a probability of 0.95 it can be argued that the average value when sampling a larger volume will not go beyond the found interval. With respect to the confidence interval for the variance, the interval (20.05; 107.88) covers the parameter

with reliability γ = 0.99.
The confidence interval for the standard deviation   S (1-q) <σ < S (1 + q) is found as an interval (4.413; 8.565), which covers the parameter σ with reliability γ = 0. We have the fact that, according to Pearson's criterion, the critical area for these statistics is always right: *[Kkr; + ∞)*. Its boundary *Kkr = χ2 (k-r-1; α)* is found by the distribution table *χ2* and given value *σ, k = 22, r = 2* (parameters and σ are estimated by sampling).   Therefore, we have: *Kkr (0.05; 19) = 30.14353*; observable criterion value   *Kobs = 4.99.*
The observed value of Pearson's statistics does not include in the critical area: Kobs <Kkr, so there is no reason to reject the main hypothesis. It is fair to assume that the sample data has a normal distribution. Let us test the hypothesis that X is distributed by normal law using the 3-sigma rule. If the random variable is normally distributed, then the absolute value of its deviation from the mathematical expectation does not exceed the triple mean deviation, that is, all values of the random variable should fall into the interval:

$$\left(\bar{x} - 3\sigma ; \bar{x} + 3\sigma \right)$$

Therefore, all values of the values fall into the interval, since

$$x_{min} = 1, x_{max} = 22 .$$

Table 3 presents the empirical frequencies and probability for the normal distribution of the world Imports coverage by Exports for Ukraine for the period 1996-2017.

TABLE 3
EMPIRICAL FREQUENCIES AND PROBABILITY FOR THE NORMAL DISTRIBUTION OF THE WORLD IMPORTS COVERAGE BY EXPORTS INDICATOR

x_i	Frequency	Probability
1	0,041	0,104
2	0,041	0,132
3	0,043	0,165
4	0,049	0,201
5	0,052	0,24
6	0,051	0,278
7	0,053	0,312
8	0,05	0,345
9	0,056	0,371
10	0,047	0,389
11	0,043	0,398
12	0,041	0,397
13	0,039	0,386
14	0,044	0,365
15	0,042	0,337
16	0,037	0,303
17	0,04	0,269
18	0,041	0,23
19	0,049	0,192
20	0,051	0,156
21	0,046	0,124
22	0,044	0,096

Figure 2 presents the visualization of Table III in the form of a normal distribution law and empirical frequency range for the world Imports coverage by Exports indicator for Ukraine for the period 1996-2017.
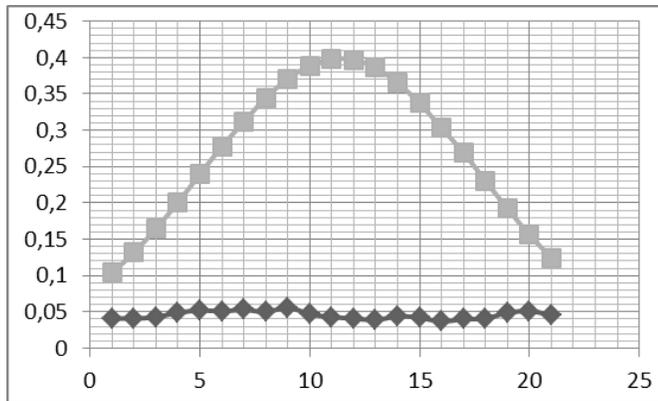
***Fig. 2**. The normal law of distribution and empirical frequency range for the world Imports coverage by Exports for Ukraine for the period 1996-2017.*

Figure 3 presents the areas of acceptable, critical and catastrophic risk under the three sigma rule, which makes it possible to analyze the belonging to these areas of the world index of Imports coverage by Exports to Ukraine, which is distributed under the normal law of distribution.
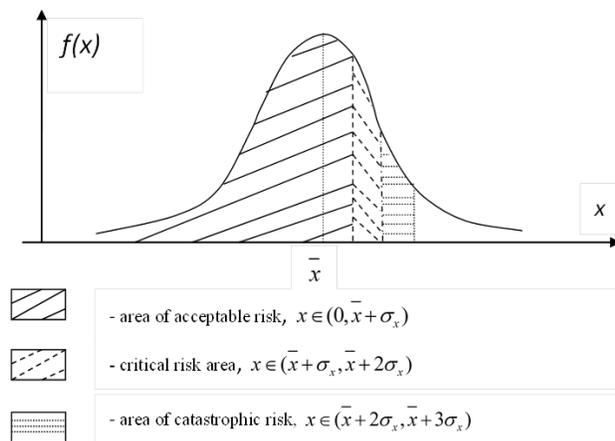

***Fig. 3**. Areas of Acceptable, Critical and Catastrophic three sigma risk for Normal probability law*

So, we have

$$x \in (0, \bar{x} + \sigma_x) = (0; 17,695);$$
$$x \in (\bar{x} + \sigma_x, \bar{x} + 2\sigma_x) = (17,695; 24,02);$$
$$x \in (\bar{x} + 2\sigma_x, \bar{x} + 3\sigma_x) = (24,02; 30,345).$$

This indicates that, after 2013, Ukraine's global export coverage of imports has fallen into the critical risk area and will be in the forecast until 2019, and then may enter the catastrophic risk zone.

4 DISCUSSION

The forecast result of the analysis that Ukraine's global Imports coverage ratios by Exports has fallen into the critical risk zone is linked to the tense political situation in the country that began in 2013. Starting in 2014 and up to the present, Ukraine is in a state of military conflict with Russia (invasion of Donbass after the conquest of Crimea), which has an international character. In the context of the general neo-imperial Russian aggressive policy on the world stage, the conflict in the East of Ukraine, according to the UN, "has been one of the deadliest in Europe since World War II." In the five years of the war, 13,000 people were killed in the Donbas, 28,000 wounded, and about 1.8 million residents of the Donbass and Crimea became internally displaced. It occupied 17 thousand km2 of Donetsk and Lugansk regions, together with Crimea it makes up 43.7 thousand km2 - that is 7.2% of the territory of Ukraine. 409.7 km of the Ukrainian-Russian border remains uncontrolled. Ukraine has suffered huge financial and economic losses. 27% of the Donbas industrial potential was illegally transferred to Russia, including the equipment of 33 local industrial giants [12]. In our opinion and the opinion of the whole international community, ending this conflict will contribute to a new development of Ukraine's foreign trade relations with the countries of the world. In the context of foreign trade, Ukraine has a foreign trade relationship and a desire to cooperate with both the more developed countries of the world and with countries with low economic potential today.

5 CONCLUSION

Areas of permissible, critical and catastrophic risk by the rule of three sigmas are presented, which makes it possible to analyze the belonging to these areas of the world index of coverage of imports by export for Ukraine, which is distributed according to the normal law of distribution. Thus, the Russian occupation of the Donbass, which is part of the "hybrid" war against Ukraine, which began in February 2014. illegal annexation of the Crimea - is a major factor in influencing Ukraine's foreign trade security. Also today there are a number of obstacles and barriers to escape from the crisis situation that has gripped Ukraine's foreign trade, from the lack of sufficient investment to produce export-oriented goods and services to the non-acceptance of Ukrainian products on the world market. The prospective development of foreign trade in Ukraine requires strategic transformations in national foreign trade policy. The main direction of its development is the use of instruments to increase export volumes of goods and services and reduce the country's import dependence, in particular on goods. At the same time, the structure of export and import should be optimized with a focus on reducing the volume of the latter.

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4846

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