Development trends and risk factors of meat global exports

Ekaterina Pozdniakova, Vladimir Pozdniakov, Andrey Brench

Belarusian State Agrarian Technical University, Minsk, Belarus

Keywords:

Meat
Export
Risk
Trend

Article history:

Received 03.01.2019
Received in revised form 08.07.2019
Accepted 30.09.2019

Corresponding author:

Ekaterina Pozdniakova
E-mail: bgatu-nii@tut.by

DOI:
10.24263/2304-974X-2019-8-3-18

Abstract

Introduction. The aim of the research was to identify and analyze the most significant factors of economic risk and to build an adequate mathematical model describing their impact on the volume of meat products exports.

Materials and methods. The object of the research was the world market of meat and meat products. The subject of the research was the factors of economic risk arising in the sphere of export relations. The assessment of risk factors impact is made on the basis of correlation and regression analysis.

Results and discussion. The volume of world exports of meat and meat products from 2013 to 2017 increased by 3.16 million tons. The increase in export volumes occurred mainly due to the main exporting regions: USA, Brazil, EU countries, Canada, Thailand and New Zealand. At the same time, there was a decrease in exports from Australia, India, China, Argentina. World pork exports in 2017 amounted to 8.23 million tons, which was 1.1 million tons, or 15.59%, higher than the level of 2013. The growth of beef's export meat was established by 22.6% during the analyzed period. The world export volume of poultry meat increased, which over the analyzed period increased from 12.4 million tons in 2013 to 13.13 million tons in 2017 (an increase of 105.9%). Global volumes of mutton exports increased slightly from 2013 to 2017 by only 1.0%.

The main risk-forming factors limiting export volumes were identified and quantified: changes in animal feed prices, the spread of various epidemiological diseases in the territory of exporting countries, the level of state support for agriculture, and exchange rate volatility. A correlation analysis of export volumes of the European Union showed its strong dependence on the average feed cost per 1 kg of slaughter weight (correlation coefficient value -0.87) and the level of state support for agriculture (correlation coefficient value 0.56). These factors of variation are defined as significant and used for regression analysis. The constructed regression model describes the dependence of meat's export volumes on changes in the most significant factors of variation as follows: an increase in the average feed cost (per 1 kg of slaughter weight) by $ 1 will reduce the export volume of European Union countries by 2.52 million tons; 1% increase in the level of state support for agriculture (% of GDP) will ensure the growth of export volume by 3.85 million tons.

Conclusions. The impact of risk factors on the export volume of the European Union countries has been assessed on the basis of the correlation and regression analysis, which allows to determine the variable factors having the greatest impact on the resulting indicator and to make an objective quantitative assessment of their impact.

Introduction

The global market of meat and meat products functions and develops under conditions of fierce competition [8], in which economic risk factors encourage investment [10], optimization [5], restructuring [6] and expansion [18] of the meat industry, thereby increasing its importance among other sectors of the global economy. The final results of production are largely predetermined by the ability of the producer to identify the economic risk factors accompanying his activities [12, 22, 32], and effectively manage them [15, 23, 26, 45]. Therefore, the analysis of development trends and risk factors of the world market of meat products is an actual economic task. According to the scientific hypothesis, the volume of meat products exports correlates not only with economic indicators, but also largely depends on the number of epidemiological outbreaks of infectious animal diseases [20, 34, 36]. To confirm this hypothesis, systematic scientific research is required. The analysis of literary sources has shown that at present there are no adequate mathematical models allowing to make scientifically grounded assessment of risk-forming factors impact on world meat products export. On this basis, the purpose of the study is to identify and analyze the most significant factors of economic risk and to build an adequate mathematical model describing their impact on the volume of exports of meat products.

Materials and methods

Object (and subjects) of research

The object of the research was the world market of meat and meat products. The subject of the study was the economic risk factors arising in the field of export relations of the European Union countries.

Analysis of development trends of the global meat products market

The statistical data of the Food and Agriculture Organization of the United Nations and the Organization for Economic Cooperation and Development have been used to analyze the volume and structure of meat and meat products production [14, 24].

Risk-forming factors of global meat export

Identification of risk-forming factors has been made on the analysis of fluctuation conditions of meat production export volumes on the basis of statistical data of the Food and Agriculture Organization of the United Nations, the Organization for Economic Cooperation and Development, the World Organization for Animal Health (MEB) [16, 25, 34, 36, 47].

Assessment of risk factors impact

The risk factors impact's assessment has been made on the correlation-regression analysis's basis [1, 21, 35, 48, 49], which provides identification of the dependence's degree of the output function on risk factors, the most significant ones selection and regression model's construction, which allows predicting the export volume's change at variation of analyzed parameters[11, 15].

Results and discussion

Analysis of development trends of the global meat products market

According to the results of the analysis, the main meat-producing regions did not significantly change their positions in the period from 2013 to 2017 (Table 1) [27–32, 37–41].

Table 1

Meat production by world countries and regions in the period from 2013 to 2017, million tons

Countries and regions	Years					Share in (2017), %	
	2013	2014	2015	2016	2017	the region	the world
Africa	**17,93**	**18,22**	**18,97**	**19,08**	**19,38**	**100,0**	**5,8**
Egypt	2,14	2,21	2,25	2,21	2,18	11,3	0,7
Nigeria	1,37	1,38	1,42	1,41	1,43	7,4	0,4
Asia	**135,30**	**138,45**	**139,77**	**140,46**	**141,65**	**100,0**	**42,4**
China	87,34	88,75	86,64	86,11	86,89	61,3	26,0
India	6,74	6,92	7,03	7,15	7,26	8,4	2,2
South America	**40,77**	**41,56**	**42,51**	**42,63**	**43,79**	**100,0**	**13,1**
Brazil	25,43	26,04	26,73	26,53	27,59	63,0	8,3
Argentina	5,34	5,24	5,42	5,33	5,76	13,2	1,7
North America	**55,97**	**56,28**	**57,07**	**58,67**	**60,18**	**100,0**	**18,0**
The USA	42,75	42,83	43,25	44,61	45,77	76,1	13,7
Mexico	6,12	6,22	6,37	6,57	6,82	11,3	2,0
Europe	**58,11**	**59,22**	**61,26**	**62,94**	**62,82**	**100,0**	**18,8**
The EU – 28	44,41	45,09	47,01	47,93	48,16	76,7	14,4
Russia	8,55	9,07	9,13	9,43	9,9	15,8	3,0
Ukraine	2,42	2,39	2,35	2,35	2,34	3,7	0,7
Belarus	1,17	1,07	1,15	1,17	1,21	1,9	0,4
Oceania	**6,43**	**6,81**	**6,95**	**6,70**	**6,41**	**100,0**	**1,9**
Australia	4,54	4,88	4,97	4,69	4,45	69,4	1,3
New Zealand	1,36	1,38	1,43	1,44	1,39	21,7	0,4
WORLD	**314,52**	**320,53**	**326,53**	**330,48**	**334,23**	**-**	**100,0**

Footnote – The table is compiled by the author according to FAO data.

Thus, from 2013 to 2017, global production of meat and meat products increased by 6.3%, or 19.7 million tons, to 334.23 million tons. The share of Asian countries is the highest throughout the analyzed period, but it tends to decrease from 43% in 2013 to 42.4% in 2017. The share of European countries increased by 0.3% to 18.8% over this period. North and South America provided an increase of 0.2%, respectively. The share of African countries did not change significantly and amounted to 5.8% in 2017. The share of Oceania fell slightly to 1.9% in 2013-2017. The volume of meat production in the Republic of Belarus from 2013 to 2017 increased by 0.03 million tons, or 3.5%, and amounted to 1.21 million tons [1].

Since 2017 the main meat producers have been China (26%), 28 EU countries (14.4%), the USA (13.7%), Brazil (8.3%), Russia (3%), India (2.2%), Mexico (2%), Argentina (1.7%), Australia (1.3%). Meat production in the leading countries increased by 11.5 million tons over the past five years and amounted to 238.2 million tons in 2017, or 71.3% of the global volume.

Meat products are produced in almost all regions of the world and are the main source of animal proteins in the human diet [2]. The meat and slaughter products market is characterized by a relative homogeneity of its nomenclature (a small number of slaughter animal species). This segment is mainly represented by such types of meat as beef, pork, poultry and mutton (rabbit, horse meat and other types of meat occupy a small share in the production's structure) (Table 2).

Table 2

Dynamics of the structure of world meat production in 2013-2017 by species, mln. t

Beef			**Pork**		
Countries and regions	Share of global production in 2017, %	Changes in 2017 by 2013, %	Countries and regions	Share of global production in 2017, %	Changes in 2017 by 2013, %
The USA	17,15	101,3	China	46,30	99,2
Brazil	13,72	98,7	The EU 28	19,78	105,1
The EU 28	11,31	106,4	The USA	9,69	110,4
China	9,93	107,8	Вьетнам	3,11	115,5
Argentina	4,08	100,7	Brazil	3,08	118,3
India	3,62	103,7	Russia	2,95	125,2
Australia	3,09	91,1	Canada	1,79	108,1
Mexico	2,77	106,6	Philippines	1,54	109,5
other countries	34,33	119,3	Mexico	1,20	112,5
World	100,00	107,5	other countries	10,56	105,2
			World	100,00	104,1
Poultry meat			**Mutton**		
Countries and regions	Share of global production in 2017, %	Changes in 2017 by 2013, %	Countries and regions	Share of global production in 2017, %	Changes in 2017 by 2013, %
The USA	18,20	110,8	China	30,89	114,7
China	15,52	100,4	The EU 28	6,34	99,0
The EU 28	12,08	114,7	Australia	4,82	110,6
Brazil	11,38	111,5	India	4,82	97,3
Russia	3,69	130,3	Pakistan	3,30	106,4
India	3,03	128,8	New Zealand	2,97	93,8
Mexico	2,73	117,2	Turkey	2,71	117,1
Indonesia	1,87	122,5	other countries	44,16	104,7
Turkey	1,84	125,0	**WORLD**	100,00	107,1
other countries	29,66	109,4			
WORLD	100,00	110,8			

Footnote – The table is compiled by the author according to FAO data.

Production growth can be noted in all commodity groups: pork production increased by 4.16% (4.79 million tons), beef production - by 2.41% (1.65 million tons), poultry production - by 10.51% (11.6 million tons), mutton production - by 8.48% (1.2 million tons) [2].

The pork production leaders were China, the EU countries – 28, the USA, Vietnam, Brazil, Russia, Canada, the Philippines and Mexico in 2017. The output of these regions amounted to 107.12 million tons, or 89.4% of the global output.

Global beef production growth in 2013-2017 was mainly provided by increasing production in the USA, the EU countries – 28, China, Argentina, India and Mexico. At the same time, it was restrained by a decrease in production volumes of this product in Brazil and Australia. The beef production's share in the largest beef-producing countries was 65.7%, or 45.71 million tonnes, of global beef production in 2017.

The increase in poultry production throughout the analyzed period was due to the growth in production volumes of major producing countries - the USA, China, the EU – 28, Brazil, Russia, India, Mexico, Indonesia and Turkey. In 2017, poultry output in these countries amounted to 86.07 million tonnes, or 70.34% of the global total [17].

The data analysis showed that China dominates the global production of mutton: in 2017, the share of this state in output was 30.89%. There are also EU countries – 28, Australia, India, Pakistan, New Zealand and Turkey among the main producers (Figure3) [7]. These countries produce 56% of this type of meat.

Risk-forming factors of global meat export

The volume of global meat export increased by 3.16 million tons in 2013–2017 [27–32, 37-41]. The increase in export was mainly due to the main exporting regions: the USA, Brazil, EU countries, Canada, Thailand and New Zealand (Figure1). Moreover, during the analyzed period, there was a decrease in exports from Australia, India, China and Argentina.

World pork exports in 2017 amounted to 8.23 million tons, which was 1.1 million tons, or 15.59%, higher than the level of 2013. At the same time we can note an increase in sales in the EU countries, the USA, Canada, Brazil and Mexico, while in China there was a significant decrease in exports (by 35.29%) (Figure2).

The main reason for the decline in exports from China was the restructuring of the pork industry and the consolidation of the meat and meat products market, which inevitably led to qualitative changes in the industry. It was associated with the redistribution of pork production in large industrial enterprises.

The need for this process was caused by the lack of the environmental safety's necessary level, which the main subjects of the sector - private households, was not able to provide. [3]. As a result, ASF (African Swine Fever) was widespread throughout the country and was difficult to control with the current production structure. The primary meat-processing sector of China has been undergoing a restructuring process since 2008. However, the concentration of the industry remains at a low level. Private farms dominate the total pork production in China and occupy more than half of the market. Significantly, more stringent environmental standards were adopted to achieve the goal of meat sector concentration in the country, which led to a significant reduction in the sow's number. In December 2016, the number of fattening sows and pigs decreased by 3.6% and 4.2%, respectively, compared to the same period last year. In 2017, the volume of imports to China accounted for 6% of total pork consumption. Unfortunately, this figure will amount to 7% by 2020, according to projections by FAO because the opportunities to increase domestic production will not be able to get ahead of sustainable consumption growth.

Countries and regions	Years				
	2013	2014	2015	2016	2017
The USA	7,57	7,54	6,93	7,31	7,72
Brazil	6,42	6,55	6,69	6,97	7,02
The EU –28	4,02	4,02	4,35	5,16	4,99
Australia	1,97	2,25	2,22	1,86	1,91
Canada	1,72	1,7	1,75	1,86	1,92
India	1,77	1,97	1,71	1,67	1,74
Thailand	0,8	0,85	0,96	1,03	1,11
New Zealand	0,92	0,97	1,03	0,96	0,99
China	0,71	0,73	0,6	0,53	0,59
Argentina	0,6	0,56	0,45	0,45	0,55
WORLD	**29,67**	**30,61**	**30,54**	**31,86**	**32,83**

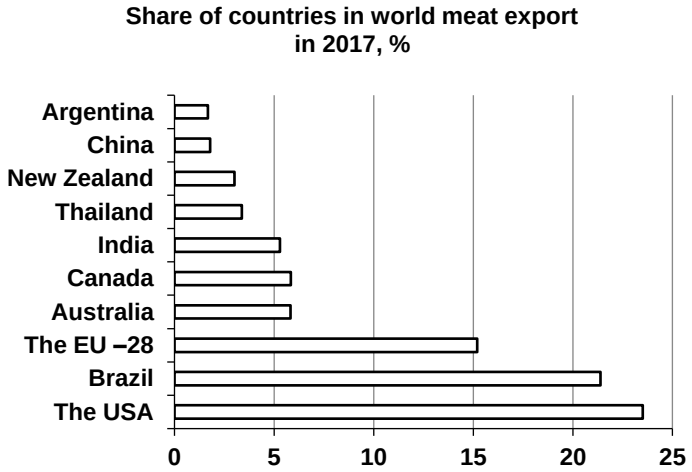

Figure 1. Dynamics and structure of world meat and meat products exports by country

Leading beef exporters, which accounted for 83.7% of world trade in 2017, included Brazil (18.2% of world beef exports), the United States (14.6%), India (16.6%), Australia (13.3%), New Zealand (5.3%), the EU (4.8%), Canada (4.3%), Uruguay (3.8%), Paraguay (3.4%), Argentina (3.0%) (Figure 3)

In the process of analysis, the growth of export deliveries of beef meat was established by 22.6% during the analyzed period. The increase in sales volumes of these products was observed from 2013 to 2017 in all major producing countries, except Australia and India, where a decrease in exports of this type of products by 6.2% and 2.3%, respectively, was observed.

Countries and Regions	Years				
	2013	2014	2015	2016	2017
The EU 28	2,29	2,21	2,42	3,12	2,85
The USA	2,17	2,13	2,19	2,29	2,44
Canada	1,21	1,18	1,19	1,26	1,3
Brazil	0,65	0,65	0,69	0,89	0,86
Mexico	0,12	0,13	0,14	0,15	0,18
Chile	0,16	0,16	0,17	0,16	0,16
China	0,17	0,2	0,13	0,1	0,11
WORLD	**7,12**	**6,97**	**7,24**	**8,28**	**8,23**

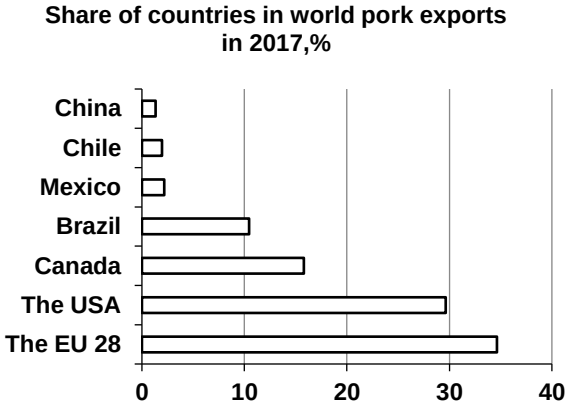

Figure 2. Dynamics and structure of world pork export by countries

The decrease in exports from Australia was a result of two-year draught period, partial herd liquidation , global competition strengthening, and also Australian dollar strengthening (predominantly against the USA dollar). In India a slight decline of exports was caused by the measures of state intervention of meat market, which resulted in introducing restrictions on cattle sale and purchase for slaughter on all cattle markets.

The world volume of poultry exports changed increasing in the analyzed period from 12.4 mln. tons in 2013 to 13.13mln tons in 2017 (the growth rate was 105,9 %). The main suppliers to export market in 2017 were: Brazil (32,6 % from the world export of poultry meat), the USA (28,7 %), the EU countries (11,8%), Thailand (8 %), Turkey (3,4 %), China (3,3 %). As a whole their share amounted 87,7 % of the world market (Figure7). It should be noted that from the analyzed period the volume of exports reduces in the USA and China by 9,2 % and 8,5 % respectively.

The USA has been the leading exporter of poultry meat in the world for over a long period. However, the situation changed greatly due to the outbreak of Highly Pathogenic Avian Influenza (HPAI), which induced the importers to seek alternative sources of supply and, as a result, brought Brazil to the first place among exporters of poultry meat. Because of the restrictions imposed in the USA and spread of HPAI, China experienced lack of breeding material supply, which also made a significant impact on the export volume. According to the FAO data due to the continuous outbreaks of avian influenza in China further decrease in production volumes and poultry meat exports are forecasting.

Countries and regions	Years				
	2013	2014	2015	2016	2017
Brazil	1,77	1,84	1,7	1,69	1,86
The USA	1,23	1,22	1,22	1,34	1,49
Australia	1,45	1,68	1,7	1,35	1,36
India	1,75	1,93	1,68	1,64	1,71
New Zealand	0,48	0,53	0,58	0,54	0,54
EC 28	0,28	0,32	0,45	0,46	0,49
Canada	0,31	0,34	0,38	0,42	0,44
Uruguay	0,32	0,31	0,34	0,38	0,39
Paraguay	0,3	0,36	0,35	0,36	0,35
Argentina	0,2	0,22	0,2	0,23	0,31
Belarus	0,15	0,13	0,14	0,16	0,14
WORLD	**8,35**	**9,07**	**9,91**	**9,67**	**10,24**

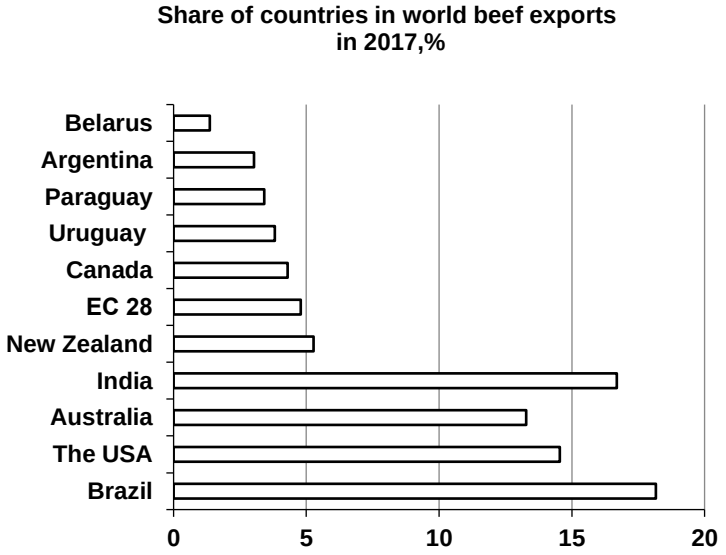

Figure 3. Dynamics and structure of world beef exports by country

World volumes of mutton exports increased slightly from 2013 to 2017 by only 1.0% (Figure 5). We have identified the main mutton exporting countries where exports of this product increased or decreased. The increase in mutton exports occurred in Australia (+4.7%), while the decrease was observed in New Zealand (-2.5%) and the EU countries (-3.2 thousand tons). In India, exports remained at the same level.

Countries and regions	Years				
	2013	2014	2015	2016	2017
Brazil	3,98	1,04	4,27	4,36	4,28
The USA	4,15	4,17	3,49	3,65	3,77
The EU 28	1,33	1,39	1,39	1,5	1,55
Thailand	0,73	0,77	0,87	0,96	1,05
Turkey	0,37	0,42	0,35	0,33	0,44
China	0,47	0,47	0,4	0,37	0,43
Ukraine	0,15	0,18	0,16	0,24	0,27
Belarus	0,11	0,11	0,14	0,15	0,15
WORLD	**12,40**	**12,76**	**12,19**	**12,74**	**13,13**

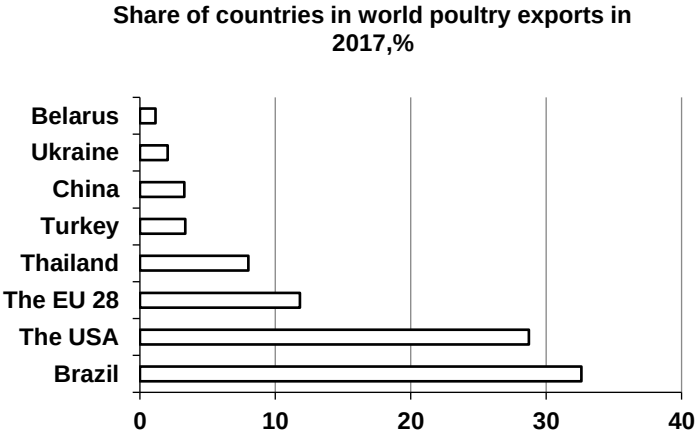

Figure 4. Dynamics and structure of world poultry exports by country

Having analyzed the main tendencies of development of the world meat market export, it can be concluded that its limitations is mainly due to the following risk-forming factors:

- increase in prices for animal feed, the growth of costs for raw materials production and processing, auxiliary materials, electricity, etc. [4, 23, 42, 43];
- the spread of various epidemiological diseases in exporting countries (e.g, African Swine Fever, Highly Pathogenic Avian Influenza) [20];
- state stimulation of domestic consumption growth, as well as development and implementation of targeted state programs aimed at increasing consumption of meat products;
- fluctuation in rates of exchange;
- actions of state authorities in the country of the counterparty and changes in legislation in the spheres affecting the activities of business entities;
- difficulties in predicting climate conditions in major exporting regions;
- conditions for the transportation and storage of meat products largely determine the regional features of product sales. This is a limiting factor of export even in case of increased production and increased demand in remote markets.

Countries and regions	Years				
	2013	2014	2015	2016	2017
Australia	0,43	0,48	0,44	0,43	0,45
New Zealand	0,4	0,39	0,4	0,37	0,39
The EU 28	0,031	0,028	0,018	0,016	0,03
India	0,02	0,023	0,022	0,021	0,02
WORLD	**0,97**	**1,02**	**0,96**	**0,91**	**0,98**

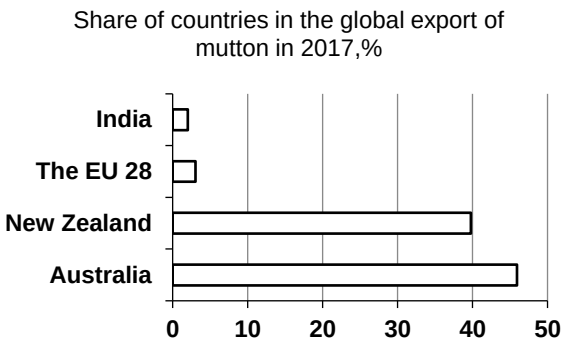

Figure 5. Dynamics and structure of world mutton exports by country

Assessment of risk factors impact

Let's consider the possibilities of applying correlation-regression analysis on the example of quantitative assessment of export activity risk factors of the European Union for 2012-2017.

The research component was as follows:

- systematization and grouping of initial data;
- determining the connection's closeness between effective and factor features in relevant period [9, 45];
- construction of a regression model [13, 44];
- analysis of obtained dependencies.

The resulting indicator (Y) was the export volume of the European Union countries for the period 2012-2017 (million tons).

Factor features were:

X_1 – average feed cost (per 1 kg of slaughter weight), (USD);

X_2 – number of epidemiological outbreaks of animal diseases (once a year);

X_3 – level of state support for agriculture (% of GDP);

X_4 – exchange rate volatility against the US dollar (%).

The use of these factors of variation for correlation and regression analysis is caused by their impact on fluctuations of export volumes and the maximum frequency of manifestation.

The boundaries of factors changes are presented in Table 3.

On the basis of the conducted correlation analysis, the values of correlation coefficients for each type of correlation between the resulting indicator and the factors of variation were determined, as well as the characteristic of connection's closeness. The degree of each factor feature impact on the resulting indicator is presented in Table 4.

Table 3

Boundaries of changes in the resulting indicator and variation factors

Indicator name	Boundaries of variation	
	Minimum value	Maximum value
Export volume (Y), mln. t	3,99	5,16
Average feed cost (per 1 kg of slaughter weight) (X1), USD	0,98	1,58
Number of epidemiological outbreaks of animal diseases (X_2), once a year	1388	9929
Level of state support for agriculture (X_3), % of GDP	0,645	0,777
Exchange rate volatility against the US dollar (X_4), %	-3,22	+19,64

Table 4

Characteristics of the connection's closeness between the indicators

Interrelated indicators	Symbol of relationship	Correlation coefficient value	Characteristics of connection's closeness
Export volume (Y), mln. t Average feed cost (per 1 kg of slaughter weight) (X_1), USD	У↔X_1	– 0,87	Very strong
Export volume (Y), mln. t Number of epidemiological outbreaks of animal diseases (X_2), once a year	У↔X_2	0,37	Weak
Export volume (Y), mln. t Level of state support for agriculture (X_3), % of GDP	У↔X_3	0,56	Strong
Export volume (Y), mln. t Exchange rate volatility against the US dollar (X_4), %	У↔X_4	0,17	Too weak

The analysis of correlation coefficient values has shown a very strong and strong dependence of export volumes (Y) on the average feed cost (X_1) and the level of state support of agriculture (X_3). Therefore, these factors of variation can be determined as significant and used for regression analysis. The relationship between the number of epidemiological outbreaks of animal diseases (X_2), the volatility of the national currency exchange rate (X_4) and the volume of meat and meat products export from the European Union is assessed as weak and very weak, respectively.

In order to be able to predict changes in the export volume of the European Union (EU) countries with the variation of the average feed cost (X_1) and the level of agriculture's state support (X_3), the mathematical dependence has been obtained, which also allows us to assess the impact of factors on the output function. The multifactor regression equation has the following form:

$$У = 4,96 – 2,52X_1 + 3,85X_3 \quad (1)$$

This correlation model reflects the close dependence of the resulting indicator on the factor ones. Multiple correlation coefficient is close to one and equal to 0.92. The reliability of the model is estimated on the level of importance of Fisher's criterion (p), which should be less than 0.05 (p = 0.0443, so the model is significant). The accuracy's degree of the process model description is characterized by the value of the determination coefficient (R-square). Since R-square = 0.85, we can talk about a satisfactory approximation (the model as a whole is adequate to the described phenomenon).

The regression equation's coefficients show the quantitative impact of each factor on the resulting index, while the others remain unchanged. The analysis shows the following trends: an increase in the average feed cost (per 1 kg of slaughter weight) by $ 1 will reduce the export volume of European Union countries by 2.52 million tons; 1% increase in the level of agriculture's state support (% of GDP) will ensure the growth of export volume by 3.85 million tons.

Conclusions

The analysis of development trends and risk factors of the world export of meat products has shown that fluctuations in export volumes are influenced by many factors: changes in prices for animal feed, spread of various diseases of epidemiological nature in the territory of exporting countries, state support for agriculture, stimulation of domestic consumption growth, fluctuations of exchange rates, etc.

The assessment of risk factors impact on the export volume of the European Union countries on the basis of correlation and regression analysis allowed us to determine that the average feed cost per 1 kg of slaughter weight (very strong feedback) and the level of agriculture's state support (strong direct dependence) have the greatest impact on the resulting indicator. Changes in the number of epidemiological outbreaks of animal diseases have little impact on the European Union meat exports. The correlation between the volatility of the national currency exchange rate and the volume of exports is assessed as very weak. The regression model, which describes the meat exports volume dependence on the change in the average feed cost per 1 kg of slaughter weight and the level of agriculture's state support, is adequate and allows predicting the change in the resulting indicator when the factors of variation change.

References

1. Anderson, T. W. (2003), An introduction to multivariate statistical analysis, Wiley-Interscience, Hoboken.
2. Apostolidis Ch., McLeay F. (2016), Should we stop meating like this? Reducing meat consumption through substitution, *FoodPolicy*, 65, pp. 74–89, DOI: 10.1016/j.foodpol.2016.11.002.
3. Arias, P., Hallam, D., Krivonos, E. & Morrison, J. (2013), Smallholder integration in changing food markets, FAO, Rome
4. Babović J., Carić M. (2011), Factors influencing the economics of the pork meat production, *Agric. Econ. Czech*, 57(4), pp. 203–209.
5. Berezina L., Samoilyk I. (2016), Problems and prospects of logistics in market of meat and meat products, *Zeszyty Naukowe Politechniki Częstochowskiej Zarządzanie*, 21, pp. 26–35.

6. Mokeev V.V., Bunova V.V., Perevedentceva E.V. (2015), Analysing the economic stability of an enterprise with the help of eigenstate, *Procedia Engineering*, 129, pp. 681–689, DOI: https://doi.org/10.1016/j.proeng.2015.12.091.
7. Cetin S., Myrzaliev B. (2018) Comparative Assessment of the Meat Markets in Kazakhstan and Turkey in Terms of Current Trends and Development Prospects, *Revista ESPACIOS*, 39, p. 32.
8. Clapp J. (2015), Food security and international trade: unpacking disputed narratives. Background paper prepared for The State of Agricultural Commodity Markets 2015–16, FAO, Rome.
9. Cohen J., Cohen P. (2012), *Applied Multiple Regression and Correlation Analysis*, *vol.1*, Lawrence Erlbaum Associates, New Jersey.
10. Creel Jérôme, Hubert Paul, Labondance Fabien (2015), Financial stability and economic performance, *Economic Modelling*, 48(C), pp. 25–40, DOI: 10.1016/j.econmod.2014.10.025.
11. Eck D.J. (2018), Bootstrapping for multivariate linear regression models. *Statistics & Probability Letters*, 134, pp. 141–149.
12. Edwards D. S. , Christiansen K. H. (1999), Determination of farm–level risk factors for abnormalities observed during post–mortem *meat inspection of lambs: a feasibility study*, *Epidemiol*. Infect. Cambridge University Press, 123, pp. 109–119.
13. Fern´andez–Macho J. (2012), Wavelet multiple correlation and cross–correlation: a multiscale analysis of Eurozone stock markets, *Physica A: Statistical Mechanics and its Applications*, 391, pp. 1097–1104.
14. (2017), *Food Industry of the Ukraine and the World. Forecast: Global meat production to increase by 13% by 2026.*
15. Girdžiūtė L., Slavickienė A. (2013), Economic Risk Assessment in Agriculture. *Economics and Management: Current Issues and Perspectives*, 19(4), pp. 218–227.
16. Ivanova V.N., Tatochenko A.L. (2018), Assessment of the problems in food industry development of the of the Russian Federation and ways of their solutions, *Revista ESPACIOS*, 39, p. 11.
17. Jafrizal (2017), Analysis on productivity of meat processing industry in Indonesia, *RJOAS*, 2(62), p. 255, DOI: 10.18551/rjoas.2017-02.30
18. Karakayaci Z. (2019), Perception of Risk Factors and Determination of Risk Management Strategies According to Agricultural Enterprise Typologies, *Turkish Journal of Agriculture – Food Science and Technology*, 7(2), pp. 333–343, DOI: 10.24925/turjaf.v7i2.333-343.2298.
19. Kataeva N.N. (2015), Analysis of industrial enterprise sales policy, *Nauka–Rastudent.ru*., 1(13), p. 4.
20. Khamidulina Kh. (2014), The modern international requirements to the risk management of exposure to chemical factors and their implementation in the system of state sanitary and epidemiological supervision, *Analysis of health risk*, 2, pp. 14–19.
21. Khusainova M. (2016), Selection of Appropriate Statistical Methods for Research Results Processing, *Mathematics Education*, 11(1), pp. 303–315.
22. Krylatykh, E.N. (2010), Agrofood sector: multifunctionality, development factors, risks, *Economy of agrarian and industrial complex*, 2, pp.162–165.
23. Kuznetsova O.A. (2016), Development of integrated model of risk analysis in meat industry, *Foods and Raw Materials*, 4(1).
24. Makarova T.V., Palkina M.V. (2017), The Choice of Strategic Economic Areas of a Meat Processing Enterprise. *Revista Espacios*, 38, p. 33.
25. Mark D.R., Schroeder T.C. (2000), Identifying Economic Risk in Cattle Feeding, *Journal of Agribusiness*, 18(3), DOI:10.1017/aae.2014.8.

26. Martynova L. (2016), Risk: economic contents, factors and methods of management, *Baltic Journal of Economic Studies*, 2(2).
27. Meat and Meat Products: price and trade update. Trade and Markets Division. June 2017. Food and Agriculture Organization of the United Nations.
28. Meat and Meat Products: price and trade update. Trade and Markets Division. June 2016. Food and Agriculture Organization of the United Nations.
29. Meat and Meat Products: price and trade update. Trade and Markets Division. July 2015. Food and Agriculture Organization of the United Nations.
30. Meat and Meat Products: price and trade update. Trade and Markets Division. November 2014. Food and Agriculture Organization of the United Nations.
31. Meat Market Review, April 2018. FAO, Rome.
32. Meat Market Review, March 2019. Rome.
33. Mihova T., Nikolova V. (2014), Risk management in industrial enterprises, *Scientific proceedings XI international congress "Machines, technologies, materials"*, 4, pp. 52–55.
34. Murray N., Macdiarmid S. (2010), *Handbook on Import Risk Analysis for Animals and Animal Products. Volume 1, 2nd Edition. Introduction and qualitative risk analysis*, World Organisation for Animal Health (OIE), Paris.
35. Mussina K.P., Bachisse M. (2018), Canonical Correlation Analysis between Business Sophistication and Macroeconomic Environment, *A Secondary study of Countries Global competitiveness*, 39(18), pp. 32.
36. Neburchilova N.F., Petrunina I.V. (2016), Principles of determination of value in use for meat and meat products based on quality indicators, *Theory and practice of meat processing*, 1(3), pp. 81–95.
37. OECD/FAO (2016), OECD–FAO Agricultural Outlook 2016–2025, OECD Publishing, Paris.
38. OECD/FAO (2017), OECD–FAO Agricultural Outlook 2017–2026, OECD Publishing, Paris.
39. OECD/FAO (2018), OECD-FAO Agricultural Outlook 2018–2027, OECD Publishing, Paris/Food and Agriculture Organization of the United Nations, Rome.
40. OECD/FAO (2019), OECD-FAO Agricultural Outlook 2019–2028, OECD Publishing, Paris/Food and Agriculture Organization of the United Nations, Rome.
41. OECD/Food and Agriculture Organization of the United Nations (2015), OECD–FAO Agricultural Outlook 2015, OECD Publishing, Paris.
42. Pig Cost of Production in Selected Countries (2014), Report of Agriculture and Horticulture Development Board, 30.
43. Pig Cost of Production in Selected Countries (2017), Report of Agriculture and Horticulture Development Board, 24.
44. Plotts T. (2011), A Multiple Regression Analysis of Factors Concerning Superintendent Longevity and Continuity Relative to Student Achievement. Seton Hall University Dissertations and Theses (ETDs), 484, Available at: https://scholarship.shu.edu/dissertations/484
45. Thorndike R. M. (2000), *Canonical Correlation Analysis. Handbook of Applied Multivariate Statistics and Mathematical Modeling*, Available at: http://max2.ese.u
46. Urodovskikh, V.N. (2010), *Risk management of the enterprise*: *Manual*, Moscow.
47. Zbarsky V.K., Lipovyak-Melkozyorova A.I. (2011), Nature of risk, his sources, criteria and assessment, *Economy of agrarian and industrial complex*, 8, pp. 61–65.
48. Streimikiene D., Baležentis T., Kriščiukaitienė I. (2016), Benefit of the Doubt Model for Financial Risk Analysis of Lithuanian Family Farms, *Economics and Sociology*, 9(1), pp. 60–68, DOI: 10.14254/2071-789X.2016/9-1/4.
49. Mentel G., Brożyna J. (2015), Compatibility of market risk measures, *Journal of International Studies*, 8(2), pp. 52–62, DOI: 10.14254/2071-8330.2015/8-2/5.