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FORECASTING OF FOREIGN TRADE INDICATORS FOR INDUSTRIAL PRODUCTS BETWEEN UKRAINE AND JAPAN

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Introduction. At the present stage of the world system, none of the countries, including Ukraine, can develop effectively without integration with the international world economy. This is due to the fact that international trade is an integral part of international relations. This allows each country to specialize in producing the product it produces more efficiently. It is due to specialization and trade that the country and the world economy as a whole get positive results.

For the last thirty years, Ukraine has been actively integrating into the world economy and conducting foreign trade operations with more than 200 partner countries. Among the large number of trading partners, Japan is a country with strong production potential, high international prestige and leading technological experience. This country ranks fourth in the world in terms of imports and exports of goods and services. Also, Japan is a leader in manufacturing and innovation and actively involved in global value chains.

In the first years of Ukraine's independence, the country's economic relations were based on the export of cars and electronics from Japan. At the present stage, relations are based on strategies of cooperation in the fields of ecology, energy, investment, etc. After the signing of the Agreement on Promotion and Mutual Protection of Investments between the countries in 2015, as well as the introduction in 2016 of a deep and comprehensive free trade area between Ukraine and the EU under the Association Agreement, Ukraine has become even more attractive to Japanese business in investment and trade aspects. New ways of cooperation require new, scientifically sound approaches to the analysis and evaluation of Ukrainian-Japanese relations and the development of new mechanisms for optimizing trade and economic cooperation.

Analysis of recent research and publications. Ukrainian researchers pay more attention to the development of foreign economic relations between Ukraine and Southeast Asia in general than Japan in particular [1]. The main directions of the strategy of Ukraine's relations with Central, South and Southeast Asia are considered in the context of defining our country's external priorities, including expanding political and economic dialogue, increasing trade and economic, scientific, technical and humanitarian cooperation, developing specific ways and effective mechanisms for attracting Asian investment resources to Ukraine's economy and strengthening the position of Ukrainian producers in the markets of leading Asian countries [2; 3].

In their study, Honcharuk and others pay considerable attention to the political relations, economic and scientific-technical cooperation of Ukraine with the countries of Southeast Asia, including Japan [4]. The authors emphasize that Japan is interested in cooperation with Ukraine, primarily in the field of trade, infrastructure development, industry, agro-industrial complex, energy-saving technologies and more. At the same time, the priority for Japanese foreign policy is relations with the United States and Asian countries, especially an economization of diplomacy. Honcharuk [5] said, Japan considers Ukraine only within Europe as an important European state given its geographical location between the countries of the European Union and Russia. The main requirements and expectations of Japanese business towards Ukraine are transparency of the economy, ensuring a stable favorable in vestment climate, and guarantees for investments. In turn, Ukraine is interested in developing economic cooperation with Japan in the field of high technology, attracting investment for the development of infrastructure and industry [6]. Bielieskov emphasizes Ukraine's expectations regarding: receiving assistance from Japan in the process of modernization and reforms through the implementation of intergovernmental programs, increasing mutual trade and foreign direct investment; attracting Japanese corporate capital to modernize Ukraine's economy. In the context of Russia's continued aggression against Ukraine, it is important to maintain existing political and economic support for Ukraine, as well as to maintain the sanctions and restrictive measures imposed by Japan against Russia, and so on. Moshko [7] also emphasizes Ukraine's interest in Japan's investment capital and highlights the importance of the cooperation between the two countries in the field of security, financial assistance and culture. Honcharuk and others [4] conduct a comparative analysis of the trade and economic relations of Ukraine with the countries of East, Southeast and South Asia. The authors point out that as of mid-2020, the share of foreign direct investment in Ukraine from Japan in total amounted to only 0.5%. Among the main priorities of Ukraine in the development and deepening of trade and economic relations with Japan should be the infrastructure projects; energy industry; agricultural sector.

In general, according to the literature review, many of the issues are devoted to the intensification of Ukrainian-Japanese cooperation in investment and scientific and technical spheres. At the same time, the issue of cooperation in the trade and economic sphere needs further study.

Objectives of the article. Accordingly, the purpose of the article is to analyze, assess and forecast the development of foreign economic relations between Ukraine and Japan. Particular attention will be paid to the development of a forecast model for a possible increase in domestic industrial output to Japan.

The methodological base of the article is critical and scientific analysis, methods of generalization and systematization, induction and deduction (in determining the causal relationship between internal and external factors affecting bilateral cooperation, trade and economic sphere). To predict the volume of export of domestic products to Japan, adaptive forecasting methods were used: Holt model, Holt-Mure model. The results of the research, conclusions and recommendations are substantiated on the basis of an integrated approach.

The main material of the study. Japan, compared to Asian countries such as China and India, has the lowest volume of foreign trade with Ukraine. Thus, the volume of exports of domestic industrial products to Japan in 2020 amounted to 341,5 million US dollars, which is 4.2 times more than in 2002 (Figure 1). The largest volumes of exports to Japan were fixed in 2013 in the amount of 458.4 million US dollars.

The volume of imports of industrial goods from Japan for the same period increased 6 times and in 2021 amounted to 1213,5 million US dollars. The largest volumes of imports of Japanese goods to Ukraine were in pre-crisis 2008 and amounted to 2795.4 million dollars. This is almost 15.2 times more than in 2002 and 2.3 times more than in 2021. Throughout the study period, Ukraine has a negative foreign trade balance. In 2021, the foreign trade balance amounted to 872,0 million US dollars.

The study of the structure of foreign trade between Ukraine and Japan showed the main industrial goods exported to Japan during 2002–2021. There were such goods, as aluminium and aluminium products; nuclear reactors, boilers, machines, equipment and mechanical devices, and their parts; ferrous metals; milk and dairy products, poultry eggs, natural honey, edible products of animal origin; various chemical products; inorganic
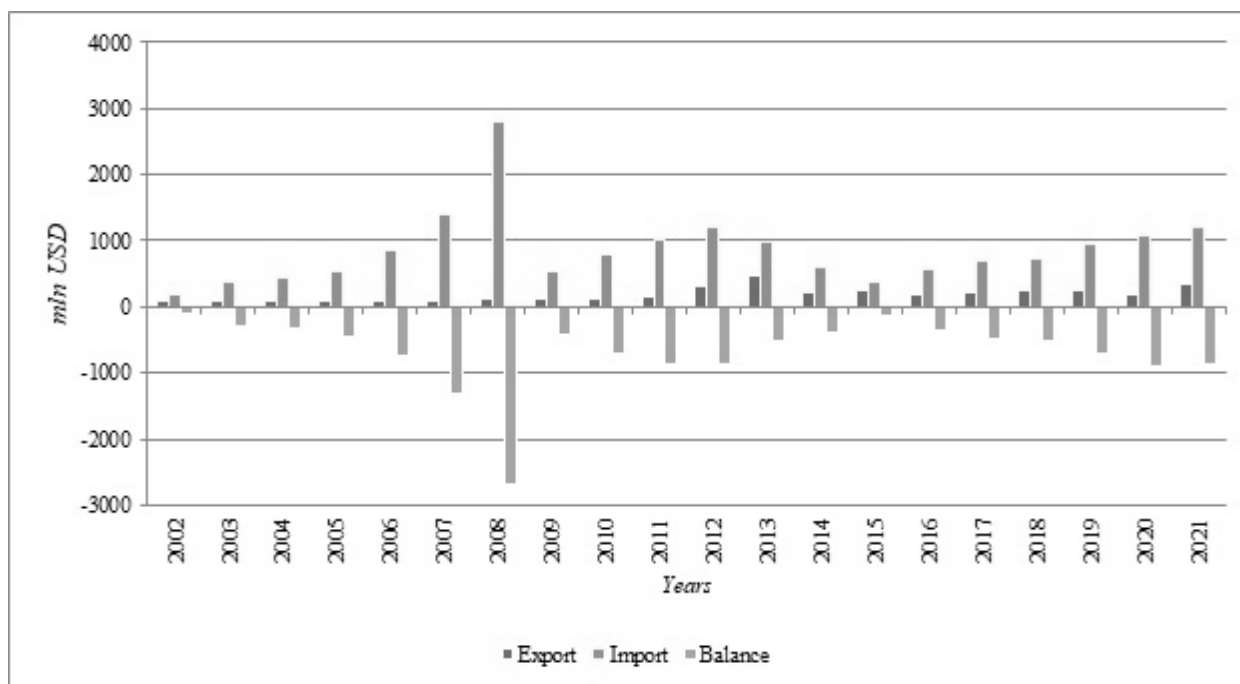
Figure 1. Dynamics of Ukraine's Foreign Trade with Japan in 2002–2021, million USA dollars
Source: Bilateral trade between Ukraine and Japan Product [8]

chemistry products; electrical machines, equipment and their parts; other base metals; ores, slags and ashes; tobacco and industrial tobacco substitutes (Table 1).

In general, during 2002–2021 the export share of these goods in the total structure of exports to Japan ranged from 27.4% to 97.9%. In 2021, the export share of these product groups in the total structure of exports was 83.3%, which is 14.6 percentage points less than in 2008. According to table 1, over the last ten years, the largest share in the total structure of exports to Japan was occupied by ores, slags and ashes (commodity groups no. 26). Its share ranged from 8.6% to 55.9% during 2010–2021. Over the past five years, domestic producers have established supplies of tobacco products and industrial tobacco substitutes to Japan (commodity groups no. 24). In particular, the share of this group in the total structure of exports increased during this period by 22.1 percentage points (from 24.1 % in 2015 to 46.2 % in 2020).

For all other product groups, there was a decrease in the overall structure of exports of Ukrainian goods to Japan during 2002–2021: the share of group 04 milk and dairy products in 2021 was 1.2% (10.4 percentage points less than in 2002); the share of group No. 28 products of inorganic chemistry decreased by 0.7 percentage points; share of group No. 38 various chemical products – by 4.3 percentage points; share of group No. 72 ferrous metals – by 12.3 percentage points; the share of group No. 76 aluminum and articles thereof – by 26.2 percentage points; share of group No. 81 other base metals – increased by 0.2; share of group No. 84 nuclear reactors, boilers, machines – decreased by 19.4 percentage points; share of group No. 85 electric machines, equipment and their parts – decreased by 0.5 percentage points.

In the general structure of imports, the main goods imported from Japan to Ukraine during 2002–2021 were mainly goods with high added value: pharmaceutical products; various chemical products; rubber, rubber and articles thereof; synthetic or artificial staple fibers; ferrous metal products; nuclear reactors, boilers, machines; electrical machines, equipment and their parts; land vehicles other than rail or tramways; optical, photographic, and cinematographic instruments and apparatus; various finished products (Table 2).

In general, the share of imports of these goods in the total structure of Japanese imports to Ukraine during 2002–2021 ranged from 89.4% to 98.3%. In 2021, the share of imports of these product groups in the overall structure of imports of Japanese goods was 94,9% (0.8 percentage points. more than in 2002). According to the data in Table 2, over the last ten years the group No. 87 land vehicles, except rail or tram has the largest share in the total structure of imports of Japanese goods to Ukraine. In 2021 the share of this group in the total structure of imports from Japan was 65,4% (0.9 percentage points more than in 2002).

Table 1

Commodity structure of exports of certain domestic industrial products to Japan in 2002–2021, %

Years	04. Milk and dairy products	24. Tobacco and industrial tobacco substitutes	26. Ores, slags and ashes	28. Products of inorganic chemistry	38. Various chemical products	72. Ferrous metals	76. Aluminium and articles thereof	81. Other base metals	84. Nuclear reactors, boilers, machines	85. Electrical machines, equipment and their parts	Total
2002	11.6	0.0	0.2	1.4	6.0	13.5	33.7	0.8	21.9	0.9	**90.0**
2003	15.9	0.0	0.0	1.3	2.7	6.8	9.8	1.3	47.4	0.8	**86.0**
2004	13.3	0.0	0.0	2.0	4.5	42.2	18.8	2.7	12.9	0.2	**96.6**
2005	11.8	0.1	0.0	5.8	7.4	18.7	45.8	2.8	0.4	0.2	**93.0**
2006	12.8	0.0	4.2	2.7	17.6	14.4	34.2	0.6	0.2	0.5	**87.2**
2007	28.7	0.0	4.3	2.4	9.2	9.7	34.7	8.7	0.1	0.1	**97.9**
2008	16.9	0.0	0.0	5.6	0.3	42.4	13.8	18.4	0.3	0.2	**97.9**
2009	0.5	0.0	3.4	2.1	0.8	6.1	12.0	1.0	10.7	1.0	**37.6**
2010	0.0	0.0	17.1	1.8	1.1	19.1	15.0	6.6	0.2	0.7	**61.6**
2011	0.0	0.0	31.1	2.1	0.8	11.1	8.9	11.6	0.5	0.6	**66.7**
2012	0.0	0.0	8.6	0.9	0.1	4.2	5.5	5.3	0.3	3.9	**28.8**
2013	0.0	0.0	18.9	3.2	0.1	2.2	2.2	0.5	0.1	0.2	**27.4**
2014	0.2	0.0	42.1	2.5	0.0	7.8	5.5	2.9	0.2	0.3	**61.5**
2015	0.2	24.1	23.4	0.6	0.0	1.0	5.2	2.9	0.5	0.2	**58.1**
2016	0.5	24.3	42.5	1.5	0.0	3.8	4.3	1.0	0.7	0.1	**78.7**
2017	0.5	29.4	47.8	0.9	0.1	1.7	6.7	1.6	0.6	0.1	**89.4**
2018	0.5	30.7	42.0	0.7	1.3	1.3	2.4	1.4	0.6	0.1	**81.0**
2019	0.4	29.0	55.9	0.2	1.6	1.7	3.7	0.1	0.8	0.2	**93.6**
2020	0.7	46.2	26.9	0.6	2.6	1.6	6.7	0.2	0.8	0.2	**86.5**
2021	1.2	23.8	43.3	0.7	1.7	1.2	7.5	1.0	2.5	0.4	**83.3**

Source: Author's calculations [8]

However, the share of group No. 87 decreased by 18.1 percentage points in 2021 compared to the pre-crisis year of 2008. The share of group No. 90 instruments and apparatus optical, photographic, and cinematographic was 8.9% in 2021 (2.3 percentage points less than in 2002). The share of group No. 84 nuclear reactors, boilers, machinery in the total structure of Japan's imports ranged from 6.4% to 12.0% in different periods. The share of group 85 electrical machinery, equipment and their parts were 4% in 2021 (0.7 percentage points less than in 2002). The share of group of 40 rubber, rubber and articles thereof ranged from 1.0% to 6.3% in 2002–2021. Its share in the total structure of Japan's imports of goods was 2.9% in 2021. That's 1.1 percentage points more than in 2002, but by 3.4 percentage points less than in 2014, when the volumes of these products were the largest. During 2002–2021, the share of imports in the group No. 30 pharmaceutical products increased by 3.0 percentage points (from 0.7% in 2002 to 3.7% in 2021). In 2021, the shares of group No. 96 different finished products increased by 0.7 percentage points (from 0.1% in 2002 to 0.8% in 2021).

However, even though Ukraine is among the top 15 steel producers the import share of group No. 73 ferrous metal products increased by 0.7 percentage points during 2002–2020 (from 0.3% in 2002 to 0.7% in 2021). The shares of imports of goods for group No. 55 synthetic or artificial staple fibers had an increase of 0.6 percentage points during 2002–2021. The share of group No. 38 of various chemical products in 2021 decreased compared to 2002 by 0.3 percentage points.

Thus, according to the analysis, the vast majority of domestic industrial products exported to Japan belong to low value-added products. However, the exports of high value-added goods account have just a small part of the overall structure of exports. The opposite situation is relative to imports of goods from Japan. Moreover, during 2002–2021, Japan managed to increase not only the export of high value-added goods, but also those goods produced in Ukraine – ferrous metal products. Alternatively, it may indicate that Japan's trade policy is effectively aimed at stimulating and supporting the export of the goods it produces.

Table 2

**Commodity structure of imports of certain industrial products
from Japanese to Ukraine in 2002–2021, %**

Years	Commodity groups										Total
	30. Pharmaceutical products	38. Various chemical products	40. Rubber, rubber and articles thereof	55. Synthetic or artificial staple fibers	73. Products from ferrous metals	84. Nuclear reactors, boilers, machines	85. Electrical machines, equipment and their parts	87. Means of land transport, except rail or tram	90. Optical, photographic, cinematographic instruments and apparatus	96. Various finished products	
2002	0.7	0.9	1.8	0.1	0.3	9.8	4.7	64.5	11.2	0.1	**94.1**
2003	0.7	0.7	1.0	0.2	0.3	6.4	3.8	78.7	4.3	0.1	**96.1**
2004	0.6	0.7	1.5	0.3	0.2	6.8	3.8	75.1	6.2	0.1	**95.3**
2005	0.8	0.7	1.9	0.3	0.2	9.2	4.8	71.1	5.1	0.1	**94.0**
2006	0.7	0.4	1.8	0.1	0.2	8.4	3.8	75.5	4.8	0.1	**95.8**
2007	0.6	0.3	1.6	0.2	0.2	9.0	1.9	78.0	5.0	0.1	**96.9**
2008	0.5	0.2	1.6	0.1	0.5	6.9	1.7	83.5	3.4	0.0	**98.3**
2009	2.7	0.7	3.9	0.4	0.6	9.4	5.9	64.0	4.5	0.1	**92.4**
2010	1.6	0.7	3.7	1.2	0.5	7.1	4.2	67.2	6.0	0.2	**92.3**
2011	1.7	0.8	4.0	1.2	0.3	7.4	4.5	66.4	8.1	0.2	**94.6**
2012	1.5	0.6	3.9	1.2	0.9	8.2	14.1	54.5	10.6	0.2	**95.8**
2013	1.4	0.9	5.3	1.2	0.9	8.4	6.0	62.1	7.5	0.2	**94.0**
2014	2.0	1.3	6.3	2.1	1.2	10.7	9.7	53.3	4.2	1.3	**92.0**
2015	2.4	1.2	4.4	4.0	2.1	11.1	9.8	47.1	5.8	1.5	**89.4**
2016	1.9	1.1	3.0	2.7	1.6	12.0	7.6	54.3	6.3	1.1	**91.7**
2017	1.2	0.9	3.6	1.5	1.3	11.6	6.1	57.9	8.2	1.0	**93.1**
2018	1.3	0.6	3.6	1.7	1.9	11.5	6.4	56.8	7.4	1.0	**92.2**
2019	2.1	0.7	3.5	1.1	1.3	8.5	4.6	65.1	5.9	0.9	**93.8**
2020	4.3	0.7	3.7	0.9	1.0	7.2	3.6	64.9	8.2	1.0	**95.5**
2021	3,7	0,6	2,9	0,7	0,7	7,2	4,0	65,4	8,9	0,8	**94,9**

Source: author's calculations [8]

To accelerate the GDP growth and the expansion of export and import volumes Japan hold ongoing discussions about a some free trade agreements. In particular, in March 2018, Japan and ten other countries (Australia, Brunei, Vietnam, Canada, Malaysia, Mexico, New Zealand, Peru, Singapore, Chile) signed the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP). This was one of his campaign promises. The other 11 member states continued negotiations following the withdrawal of the United States from the Trans-Pacific Partnership Agreement. These countries represented about 13.5 percent of the world economy (10 trillion UA dollars), and the domestic market is about 480 million people [9].

On February 1, 2019, the EU-Japan Economic Partnership Agreement entered into force. This is the biggest free-trade agreement in the history of the European Union. As a result of this agreement, a new market is opened for the participating countries, where more than 635 million people live and almost a third of the world's GDP is concentrated. Japan is the EU's second-largest trading partner in Asia after China and together accounts for about a quarter of world GDP.

According to experts, this agreement will save each year about 1 billion euros through customs duties for European producers. The agreement also removes bilateral non-tariff barriers, such as those relating to the application of international car standards. It also removes barriers to European food and beverages exports to Japan, and this is a benefit for 127 million Japanese consumers. After the full implementation of the Agreement, the volume of annual trade between Japan and the EU could increase immediately by 36 billion euros. The agreement provided for the creation of the world's largest free trade zone with a population of about 800 million people. However, in January 2017, U.S. President Donald Trump signed a decree on the withdrawal of the United States. Under the agreement, Japan will abolish tariffs on 94% of its imports from the EU, including

agricultural products. The EU, for its part, will abolish tariffs on 99% of imports from Japan. The parties also intend to liberalize rules in a wide range of industries, including investment, services and public procurement.

According to Japanese officials, the signed agreement will expand trade and investment, increase the country's GDP in real terms by about 1%, and will create about 290 thousand jobs.

In general, although foreign trade is an integral part of the Japanese economy, the country is not fully open and has significant tariff and non-tariff barriers. The mechanism of customs and tariff regulation of foreign trade flows is quite complex due to the use of various instruments and differentiated in accordance with current trade agreements.

The level of protection of Japan's domestic market from imports, provided by instruments of customs and tariff regulation of foreign trade, mostly increases with the processing degree of products. For example, duty rates on certain types of clothing range from 4.4% to 20%; footwear – 30%; confectionery – from 10% to 29.8%, etc. [10].

Also among the features of customs and tariff regulation of Japan's foreign trade is the use of temporary duty rates. These rates introduce on a short-term basis to meet certain needs of the domestic market or for other reasons and always have a preferential nature over full duty rates. In addition, Japan's customs tariff is characterized by the availability of instruments such as the tariff quota, which is mostly used in free trade agreements, and seasonal duties. These duties are characterized by the presence of two periods and a reduction in the rate, mostly twice during one of them, in particular for imported fresh oranges, grapes, bananas and so on.

In general, despite its membership in the WTO, Japan actively protects its domestic markets from external competitors by establishing various barriers in the form of mandatory certification, licensing and other safeguards. In this regard, an objective question arises – what awaits Ukraine in foreign trade relations with Japan? We will try to find the answer to this question by building a forecast model based on a neural network on the dynamics of possible exports of industrial goods to Japan in the short term.

Additional information was taken for the retrospective period from 2002 to 2021 (Table 3) to forecast the volume of exports from Ukraine to Japan.

We denote by t the ordinal number of the year in this period. The volume of exports to Japan in the t-th year of the retrospective period is denoted by x (t). The values of these indicators are shown in Table 3.

Table 3

Indicators of foreign trade between Ukraine and Japan for 2006–2021, (million US dollars)

Year	Export volume	Imports volume	Import volume (data edited according to the Irwin criterion)
2006	98.6	848.7	848.7
2007	91.0	1406.6	1125.3
2008	115.7	2795.8	781.5
2009	111.2	519.5	1434.1
2010	104.8	801.7	663.5
2011	152.5	1014.1	798.2
2012	320.5	1197.8	953.2
2013	458.4	985.0	790.1
2014	209.6	612.6	485.3
2015	235.6	382.2	289.7
2016	185.2	551.8	420.8
2017	217.9	723.5	567.5
2018	231.9	737.4	586.8
2019	249.9	962.9	768.6
2020	181.7	1076.5	867.1
2021	347.2	1227.3	990.5

Source: State Statistics Service of Ukraine [11]

Since there are significant fluctuations in the series of dynamics (imports volume), we will reveal abnormal values of the series. Anomalies can be defined as patterns or data points that do not conform to a well-defined notion of normal behaviour. In contrast to noise removal and noise. Anomaly detection refers to the problem of finding patterns in data that do not conform to expected behaviour [12].

Anomalous level can occur as a result of technical errors (errors of the first kind), and also have an objective nature (errors of the second kind).

To detect anomalous values of the series, the Irwin method is used. According to this method, we will consider a point that deviates from the previous point by an amount greater than standard deviation as anomalous.

$$\lambda_i = \frac{\left| Y_t - Y_{t-1} \right|}{\sigma},$$ (1)

where λ_i – Irwin criterion; σ – standard deviation.

$$\sigma = \sqrt{\frac{\sum_{t=1}^{n} \left(Y_t - \bar{Y} \right)^2}{n-1}}.$$ (2)

A point is considered anomalous if the Table value of Irwin's criterion with the number of observations 20 is equal to 1.3. Detected anomalous values were changed by interpolation at neighboring points, Table 3.

The following adaptive methods were chosen for forecasting: Holt model, Holt-Muir model. The reason for this approach is the properties of adaptive methods and models, such as:

– a wide range of problems to which adaptive models are applied;

– adaptive models do not require a large amount of information, as they are based on intensive analysis of information contained in separate time series;

– adaptive models are distinguished by clarity and simplicity of mathematical formulation;

– the heterogeneity of time series and their connections is reflected in the adaptive evolution of parameters. They allow to achieve adequacy in the description of economic processes [13].

The Holt model was chosen for data analysis due to the fact that it is used for forecasting time series when there is a tendency for the time series to grow or fall. If the time series has an upward or downward trend, then along with the assessment of the current level of the series, you need to highlight the trend. To control the level and slope in the Holt model, the smoothing coefficients of the series and the trend are introduced.

The exponentially smoothed series is calculated by the formula:

$$L_t = \alpha \cdot y_t + \left(1 - \alpha\right)\left(L_{t-1} + T_{t-1}\right),$$ (3)

where L_t – smoothed value for the current period; α – smoothing coefficient of the series; y_t – current value of the row; L_{t-1} – smoothed value for the previous period; T_{t-1} –trend value for the previous period.

The value of the smoothing coefficient α set manually and is in the range from 0 to 1. For the first period at the beginning of the data, the exponentially smoothed series is equal to the first value of the series (for example, the net income from the sale of products (services) for the first quarter) $L_1 = Y_1$

The trend value is calculated by the formula:

$$T_t = \beta\left(L_t - L_{t-1}\right) + \left(1 - \beta\right) \cdot T_{t-1},$$ (4)

where T_t – trend value for the current period;

β – trend smoothing factor;

L_t – exponentially smoothed value for the current period;

L_{t-1} – exponentially smoothed value for the previous period;

T_{t-1} – the trend value for the previous period.

The value of the smoothing coefficient β set manually and is in the range from 0 to 1.

The trend value for the first period is 0 ($T_1 = 0$). The forecast for p periods ahead is equal to:

$$\widehat{Y}_{t+p} = L_t + pT_t,$$ (5)

where $\widehat{Y}_{t+p}$ – forecast by the Holt method for p period;

L_t – exponentially smoothed value for the last period;

p – ordinal number of the period for which we make a forecast;

T_t – trend for the last period [14].

The results of forecasting indicators of foreign trade (export and import) between Ukraine and Japan using the Holt method are presented in in Figure 2-3.

Table 4 shows the calculated forecast quality of the constructed models by adaptive forecasting methods.

As a result, the models constructed using the Holt-Muir method received the highest forecast quality values. On the basis of these models, it is proposed to determine indicators of foreign trade (export and import) between Ukraine and Japan, (Table 5).
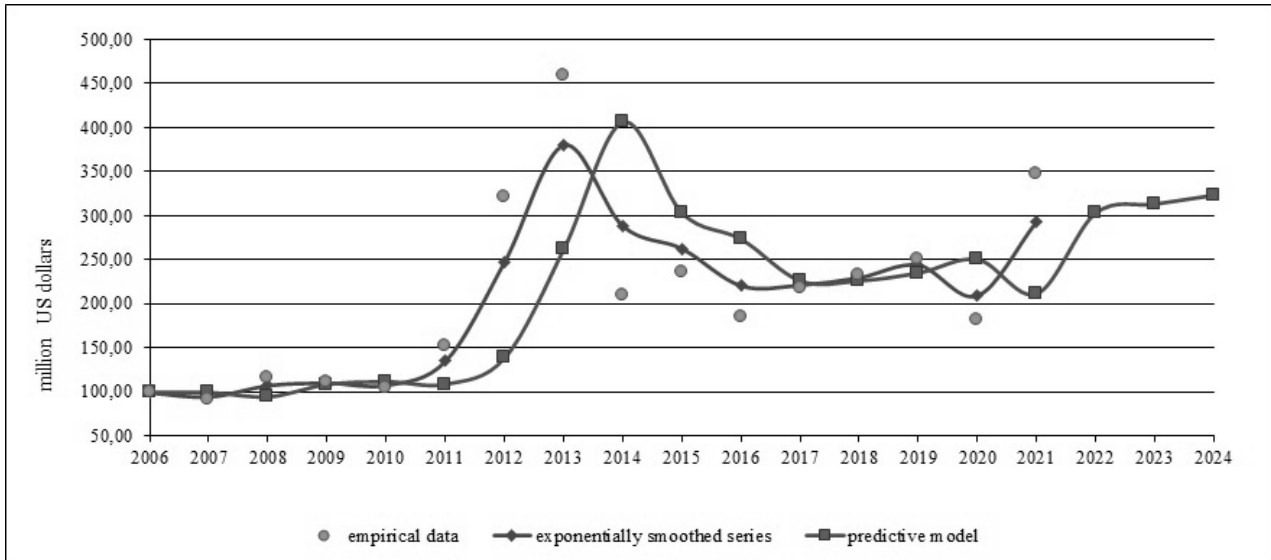
Figure 2. The results of forecasting the volume of exports using the Holt method
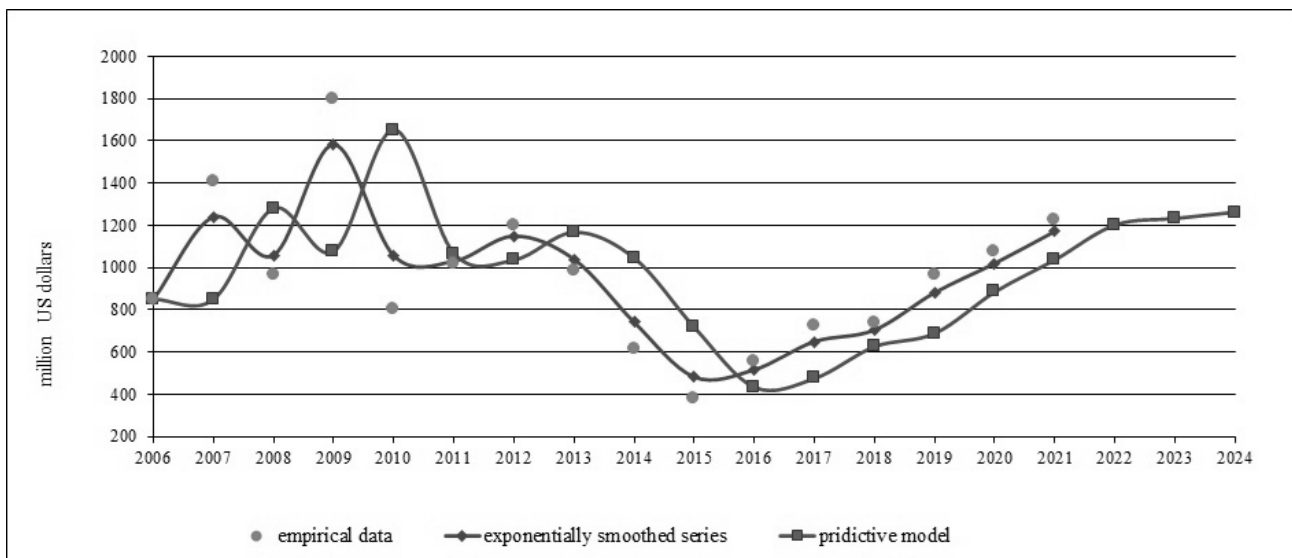*Source: author's calculations*

Figure 3. The results of forecasting the volume of imports using the Holt method
Source: author's calculations

Table 4

The quality of the models

Model	Forecast quality
Holt method (export)	82.23%
Holt method (import)	68.33%
Holt-Muir method (export)	84.08%
Holt-Muir method (import)	81.29%

Source: author's calculations

Table 5

Forecast values of indicators of foreign trade (export and import) between Ukraine and Japan for 2022–2024

Model	Forecast value for 2022, million US dollars	Forecast value for 2023, million US dollars	Forecast value for 2024, million US dollars
Holt-Muir method (export)	292.62	304.69	316.76
Holt-Muir method (import)	1064.5	1123.72	1182.94

Thus, as can be seen from Table 5, the volumes of export and import of industrial goods between Ukraine and Japan will still grow, despite the conditions of the war. This should have a positive effect on the foreign trade balance of Ukraine. It should be noted that the World Bank expects Ukraine's GDP growth to reach 0.5% in 2023 – after a sharp drop to almost "minus" 30% according to the results of last year after the beginning

of the full-scale russian invasion of Ukraine. Despite the localization of active hostilities, Ukraine's economic prospects remain extremely uncertain and depend on the duration of the war. In the medium term, economic activity is forecast to remain at the level of the fourth quarter of 2022, seasonally adjusted and taking into account recent improvements in energy supply.

In 2023, a current account deficit of 4.5% of GDP is expected. This can be explained by the fact that the growing deficit of the trade balance will absorb the expected secondary income from international grants in the amount of about 10 billion US dollars. According to experts, exports remain low due to the decline in agricultural production and the logistics problems. On the contrary, imports are expected to increase nominally by 20% year-on-year, due to the strengthening of domestic demand and the constant need for imports of energy-related goods. Total budgetary needs are estimated to exceed 41 billion US dollars in 2023. In the near term, maintaining the stable functioning of the military economy is of crucial importance. This will include the identification of opportunities to finance the increased budget deficit caused by the need to provide for defense and social spending under the condition of limited tax collection, and the need to service the domestic debt [12]. Thus, if under normal conditions, Ukraine had every chance to keep occupied export niches in Japan at the level of 2010, which was not enough to strengthen and expand the country's export potential. Today, in the conditions of military operations, it is very difficult to maintain the volume of exports to this country, but according to forecast calculations, it is still possible.

Conclusions. The analysis and forecast of exports to Japan indicate not only the aggressiveness of international marketing of Japanese entrepreneurs but also reflects the shortcomings of Ukrainian business – cannot or does not want to focus on the production and export of labor-intensive industrial products with higher value added. There are also significant gaps at the state level, which are manifested in the low implementation of existing foreign trade agreements.

Taking into account the total volumes and structure of Ukraine's exports to Japan, it can be argued that Ukraine could hope to keep the occupied niches at the level of 2010 for the indicated commodity items, which was not enough to strengthen and expand the country's export potential under normal conditions, but today, in in the conditions of hostilities, the volume of exports to this country can be reduced by at least half. Consequently, the main task for Ukraine in terms of increasing exports today is, first of all, the search for new logistics ways to resume exports, especially high-tech ones.

In general, in order to support the export of traditional industrial goods (metal products. machinery and chemical products) to Japan. Ukraine needs to create an effective state policy of innovative development of domestic industry. After all, it does not seem possible today to talk about increasing the share of high-tech goods in total industrial exports and expanding the geographical structure of exports of such goods. Among the main reasons are the lack of an innovative development model and the lack of financial resources.

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Vitalii Venger, D.Sc. (Economics), Senior Research Officer. **Nataliya Romanovska,** Ph.D. in Economics, Associate Professor, State Institution "Institute for Economics and Forecasting of National Academy of Sciences of Ukraine". **Maryna Chyzhevska,** Ph.D. in Economics, Associate Professor. **Ksenia Verhal,** Ph.D. in Economics, Associate Professor. **Svitlana Shcherbinina,** Ph.D. in Economics, National University "Yuri Kondratyuk Poltava Polytechnic". **Forecasting of foreign trade indicators for industrial products between Ukraine and Japan.**

Analysis, evaluate and forecast the development of foreign economic relations between Ukraine and Japan. Studies of scientific problems related to the intensification of Ukrainian-Japanese cooperation in the foreign economic sphere were carried out using critical and scientific analysis, methods of scientific generalization and systematization, induction and deduction. To predict the volume of exports of domestic products to Japan, the following adaptive methods for forecasting: Holt model, Holt-Muir model were used. Since there are significant fluctuations in the series of dynamics (imports volume), we revealed abnormal values of the series. To detect anomalous values of the series, the Irwin method is used. The obtained results made it possible to draw a conclusion about the existing trends of further growth in the volume of export and import of industrial goods between Ukraine and Japan despite the conditions of the war. The analysis and forecast of exports to Japan indicate not only the aggressiveness of international marketing of Japanese entrepreneurs but also reflects the shortcomings of Ukrainian business – cannot or does not want to focus on the production and export of labor-intensive industrial products with higher value added. Despite the localization of active hostilities, Ukraine's economic prospects remain extremely uncertain and depend on the duration of the war. In general, in order to support the export of traditional industrial goods (metal products. machinery and chemical products) to Japan, Ukraine needs to create an effective state policy of innovative development of domestic industry. The adaptive forecasting models presented in the article reproduce the dynamics of foreign trade relations between Ukraine and Japan. Unlike the existing ones, they are the most adequate forecasting tool in conditions of limited information and uncertainty. The results of the research presented in this work can be applied in practice for the analysis, evaluation and forecast of the development of foreign economic relations between the countries of the world.

Key words: foreign trade, Ukrainian-Japanese relations, export, import, forecasting.

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Виконано аналіз, оцінку та прогноз розвитку зовнішньоекономічних відносин між Україною та Японією. З огляду на загальну структуру імпорту – основними товарами, імпортованими з Японії в Україну протягом 2002–2021 років, були переважно промислові товари з високою доданою вартістю. Тому особливу увагу було приділено розробці прогнозної моделі, яка дозволяє дослідити імпорт та експорт. Для прогнозування обсягів експорту вітчизняної продукції до Японії було використано такі адаптивні методи прогнозування: модель Холта, модель Холта-Муіра. Оскільки в ряді динаміки (обсязі імпорту) спостерігаються суттєві коливання, аномальні значення ряду були виявлені та усунуті за допомогою методу Ірвіна. Отримані результати дозволили зробити висновок, про наявні тенденції подальшого зростання обсягів експорту та імпорту

промислових товарів між Україною та Японією незважаючи на умови війни. Аналіз та прогноз експорту до Японії свідчить не лише про агресивність міжнародного маркетингу японських підприємців, а й відображає недоліки українського бізнесу – не може чи не хоче зосереджуватися на виробництві та експорті трудомісткої промислової продукції з вищою доданою вартістю. Загалом, для того, щоб підтримати експорт традиційних промислових товарів (вироби з металу, машини та хімічні продукти) до Японії Україні необхідно створити ефективну державну політику інноваційного розвитку вітчизняної промисловості. Адже говорити про збільшення частки високотехнологічних товарів у загальному промисловому експорті та розширення географічної структури експорту таких товарів сьогодні не видається можливим. Окрім активних військових дій на території країни, серед основних причин залишилися – відсутність інноваційної моделі розвитку та брак фінансових ресурсів. Наведені у статті адаптивні моделі прогнозування відтворюють динаміку зовнішньоторговельних відносин між Україною та Японією. На відміну від існуючих, вони є найбільш адекватним інструментом прогнозування в умовах обмеженості інформації й невизначеності. Результати дослідження, представлені в даній роботі, можуть бути застосовані на практиці для аналізу, оцінки та прогнозу розвитку зовнішньоекономічних відносин між країнами світу.

Ключові слова: зовнішня торгівля, українсько-японські відносини, експорт, імпорт, прогнозування.