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ECONOMETRIC ANALYSIS OF GOODS FOREIGN TRADE DYNAMICS IN UKRAINE

The article presents the econometric models of goods export from Ukraine and the import to Ukraine in general, and also from the CIS countries, European and Asian countries separately, their seasonal and trend components are considered. The forecast of investigated indices for II, III and IV quarters of 2013 is made based on these constructed models.

Keywords: linear trend model; parabolic trend model; spot forecast; interval forecast; determination coefficient; foreign trade.

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ЕКОНОМЕТРИЧНИЙ АНАЛІЗ ДИНАМІКИ ЗОВНІШНЬОЇ ТОРГІВЛІ УКРАЇНИ ТОВАРАМИ*

У статті побудовано та досліджено, з урахуванням сезонної і трендової компонент, економетричні моделі експорту та імпорту товарів України як в цілому, так і з країнами СНД, Європи та Азії окремо. Також на основі побудованих моделей знайдено точковий та інтервальний прогнози досліджуваних показників на II, III і IV квартали 2013 року.

Ключові слова: лінійний тренд; параболічний тренд; точковий прогноз; інтервальний прогноз; коефіцієнт детермінації; зовнішня торгівля.

Форм. 1. Табл. 6. Літ. 10.

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ЭКОНОМЕТРИЧЕСКИЙ АНАЛИЗ ДИНАМИКИ ВНЕШНЕЙ ТОРГОВЛИ УКРАИНЫ ТОВАРАМИ

В статье построены и исследованы эконометрические модели, с учетом сезонной и трендовой компонент, экспорта и импорта товаров Украины как в целом, так и со странами СНГ, Европы и Азии по отдельности. Также на основании построенных моделей сделаны точечный и интервальный прогнозы исследуемых показателей на II, III и IV кварталы 2013 года.

Ключевые слова: линейный тренд; параболический тренд; точечный прогноз; интервальный прогноз; коэффициент детерминации; внешняя торговля.

Problem setting. External trade in goods plays an important role in the structure of the balance of payments. Therefore, it is necessary to determine trends of foreign trade in goods and construct their appropriate forecasts for its stability. We used the method of econometric analysis for this, considering the indices of exports and imports in goods of Ukraine in general, with CIS countries, Europe and Asia in particular.

Latest research and publications analysis. A lot of Ukrainian scientists a number of aspects related to foreign trade of Ukraine. The most significant is the research of basic trends of foreign trade of Ukraine in 1992–2009 by the scientists from the Institute of Economics and Forecast of NAS of Ukraine among the most recent works (Heyets et al., 2010). The scientists of the National Institute for Strategic Studies under the President of Ukraine analyzed the dynamics of foreign trade of Ukraine after its entering the WTO in their analytical report (Klymenko et al., 2011).

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V. Shevchuk researched Ukraine's balance of payments in his monography (Shevchuk, 2008). The problem of improving the mechanisms of government control of external economic activity in Ukraine was studied in (Kyseleva, 2012). I. Karambovych (2008) analyzed the structural changes in foreign trade of Ukraine as the most advanced forms of external economic relations. S. Makuha (2012) studied the ways of increasing the efficiency of foreign trade of Ukraine basing on the transition to innovation-investment direction of the country's development. T. Misyats (2010) analyzed the foreign trade in goods and services between Ukraine and the EU during the global crisis and the post-crisis period.

Unresolved issues. We concentrated our research on the construction of the considered indices of Ukraine's foreign trade in goods using the econometric methods (Eliseeva et al., 2002; Greene, 2005).

The objective of the research is to construct models which describe the dynamics of Ukrainian exports and imports in goods in general, with the CIS countries, European and Asian countries in particular, based on the data from the official site of the State Statistics Service of Ukraine. We also constructed forecasts of these indices for II, III and IV quarters of 2013.

Research findings. We shall construct the additive models of goods export from Ukraine and the import to Ukraine in general, from the CIS countries, Europe and Asia based on the quarterly data for 2009–2012. We shall construct the additive models as

$$Y = T + S + \varepsilon, \quad (1)$$

where Y – the investigated index; T , S , ε – trend, seasonal and random component respectively.

Let's analyze the seasonal components at the first. We obtain the following results using the method of Eliseeva et al. (2002).

Table 1. Seasonal components of the indices of Ukraine's external trade in goods for 2009–2012, mln USD

#	Indices	Quarter			
		I	II	III	IV
1	Export of goods from Ukraine in general	-1053.785	362.561	-219.409	910.633
2	Export of goods from Ukraine to the CIS countries	-420.077	-6.631	156.403	270.305
3	Export of goods from Ukraine to Europe	-334.781	304.514	-125.456	155.723
4	Export of goods from Ukraine to Asia	-249.032	-0.720	-72.397	322.148
5	Import of goods to Ukraine in general	-1505.509	-234.128	137.715	1601.923
6	Import of goods to Ukraine from the CIS countries	-156.139	-305.524	-191.230	652.893
7	Import of goods to Ukraine from Europe	-878.358	-19.117	255.171	642.304
8	Import of goods to Ukraine from Asia	-452.171	38.586	97.518	316.067

Source: Own construction based on the data from the official site of the State Statistics Service of Ukraine.

As we can see from Table 1 the seasonal components are negative for all the indices in the first quarter and are positive for the fourth quarter.

We exclude the impact of seasonal components in the established indices and determine trend components as linear trends. The relevant calculations are given in Table 2.

Table 2. Linear trend components of the indices of Ukraine's external trade in goods for 2009–2012

#	Indices	Trend equation	Determination coefficient, R^2	Empirical value of the Fisher criterion, F_{em}	Empirical value of the Durbin-Watson criterion, DW_{em}
1	Export of goods from Ukraine in general	$T_{e1}^1 = 8801.178 + 643.519 \times t$	0.884	106.629	0.486
2	Export of goods from Ukraine to the CIS countries	$T_{e2}^1 = 2991.389 + 263.498 \times t$	0.827	66.997	0.340
3	Export of goods from Ukraine to Europe	$T_{e3}^1 = 2367.080 + 162.515 \times t$	0.707	33.805	0.797
4	Export of goods from Ukraine to Asia	$T_{e4}^1 = 2764.363 + 125.285 \times t$	0.737	39.246	0.934
5	Import of goods to Ukraine in general	$T_{i1}^1 = 9814.549 + 855.949 \times t$	0.894	117.936	0.586
6	Import of goods to Ukraine from the CIS countries	$T_{i2}^1 = 4533.814 + 334.662 \times t$	0.737	39.331	0.483
7	Import of goods to Ukraine from Europe	$T_{i3}^1 = 3535.221 + 252.169 \times t$	0.882	104.573	0.915
8	Import of goods to Ukraine from Asia	$T_{i4}^1 = 1096.491 + 216.419 \times t$	0.949	260.784	2.243

Source: Own construction based on the data from the official site of the State Statistics Service of Ukraine.

$T_{e1}^1, T_{e2}^1, T_{e3}^1, T_{e4}^1$ – the normative values for the linear trend component of the export of goods from Ukraine in general, to the CIS countries, to Europe and to Asia respectively, mln USD; $T_{i1}^1, T_{i2}^1, T_{i3}^1, T_{i4}^1$ – the normative values for the linear trend component of the import of goods to Ukraine in general, from the CIS countries, from Europe and from Asia respectively, mln USD.

The fitted linear trend models describe from 70.7% (for the export of goods from Ukraine to Europe) to 94.9% (for the import of goods to Ukraine from Asia) of the variations in the considered indices.

The critical value at the significance level $\alpha = 0.05$ for the Fisher criterion is $F_{I\ tab} = 4.60$. We conclude that all constructed models correspond to the statistical data according to the F-criterion of Fisher with the probability $p = 0.95$ because of all empirical values F_{em} in Table 2 are larger than the table one.

The critical value at the significance level $\alpha = 0.05$ for the Durbin-Watson criterion are $DW_{IL} = 1.10$ and $DW_{IU} = 1.37$. So we can conclude there is no autocorrelation in residuals in case of linear models fitted to the import of goods to Ukraine from Asia and there is the positive autocorrelation in the residuals in case of all other linear models. Hence, we cannot use them directly for forecasting these indices.

Let's determine trend component for the export of goods from Ukraine to Europe by using a parabolic trend. We receive the equation $T_{e3}^p = 1564.968 + 429.886 \times t - 15.728 \times t^2$, where T_{e3}^p denote the normative value for the parabolic trend component of the export of goods from Ukraine to Europe, mln USD. This equation describes 81.8% of the variations in the considered index. We conclude that the constructed model corresponds to statistical data according to the F-criterion of Fisher with the probability $p = 0.95$ since an empirical value for this model $F_{em} = 29.295$ is larger than the table one, $F_{p\ tab} = 3.80$. The critical value at the significance level $\alpha = 0.05$ for the Durbin-Watson criterion are $DW_{pL} = 0.98$ and $DW_{pU} = 1.54$.

We consider instead of the statistical data of the indices of the export of goods from Ukraine in general, to the CIS countries and to Asia as good as of the import of goods to Ukraine in general, from the CIS countries and from Europe absolute increases of these indices compared with the same quarter of the previous year. We do this to construct the forecast of the considered indices.

Seasonal components of the absolute increases of the correspond indices of the foreign trade of Ukraine are given in Table 3.

Table 3. Seasonal components of the absolute increases of the indices of Ukraine's external trade in goods for 2009–2012, mln USD

#	Indices	Quarter			
		I	II	III	IV
1	Export of goods from Ukraine in general	676.078	420.208	-1707.476	611.190
2	Export of goods from Ukraine to the CIS countries	288.940	16.283	-395.231	90.008
3	Export of goods from Ukraine to Asia	48.485	67.652	-480.915	364.779
4	Import of goods to Ukraine in general	548.679	680.969	-1714.045	484.397
5	Import of goods to Ukraine from the CIS countries	199.023	77.642	-754.893	478.228
6	Import of goods to Ukraine from Europe	182.776	181.558	-525.761	161.427

Source: Own construction based on the data from the official site of the State Statistics Service of Ukraine.

Seasonal components are positive for all the indices for the first, second and fourth quarters and are negative for the third quarter as we can see in Table 3.

We shall consider the trend components of the absolute increases of the indices of the foreign trade of Ukraine as parabolic trends. The relevant calculations are given in Table 4.

Table 4. Parabolic trend components of the absolute increases of the indices of Ukraine's external trade in goods for 2009–2012

#	Indices	Parabolic trend	R ²	F _{em}	DW _{em}
1	Export of goods from Ukraine in general	$T_{e1}^{\Delta p} = -13351.801 + 3501.670 \times t - 174.293 \times t^2$	0.779	22.885	1.534
2	Export of goods from Ukraine to the CIS countries	$T_{e2}^{\Delta p} = -5334.210 + 1468.051 \times t - 75.411 \times t^2$	0.818	29.155	1.360
3	Export of goods from Ukraine to Asia	$T_{e4}^{\Delta p} = -2126.502 + 640.438 \times t - 33.843 \times t^2$	0.683	13.987	2.157
4	Import of goods to Ukraine in general	$T_{i1}^{\Delta p} = -19165.811 + 4878.439 \times t - 239.099 \times t^2$	0.837	33.439	1.402
5	Import of goods to Ukraine from the CIS countries	$T_{i2}^{\Delta p} = -7686.017 + 2167.909 \times t - 114.289 \times t^2$	0.819	29.492	1.653
6	Import of goods to Ukraine from Europe	$T_{i3}^{\Delta p} = -6599.416 + 1606.913 \times t - 77.454 \times t^2$	0.852	37.538	1.566

Source: Own construction based on the data from the official site of the State Statistics Service of Ukraine.

$T_{e1}^{\Delta p}$, $T_{e2}^{\Delta p}$, $T_{e4}^{\Delta p}$ – normative values for the parabolic trend component of the absolute increases of the export of goods from Ukraine in general, to the CIS countries and to Asia respectively, mln USD; $T_{i1}^{\Delta p}$, $T_{i2}^{\Delta p}$, $T_{i3}^{\Delta p}$ – normative values for the parabolic trend component of the absolute increases of the import of goods to Ukraine in general, from the CIS countries and from Europe respectively, mln USD.

The critical value at the significance level $\alpha = 0.05$ for the Fisher criterion is $F_{p\ tab} = 3.80$, whereas they are $DW_{pL} = 0.98$ and $DW_{pU} = 1.54$ for the Durbin-Watson criterion.

Using Table 4 we conclude that all the constructed models correspond to the statistical data according to Fisher criterion with the probability $p = 0.95$. The fitted linear trend models describe from 68.3% (for the absolute increases of the export of goods from Ukraine to Asia) to 85.2% (for the absolute increases of the import of goods to Ukraine from Europe) of the variations in the considered indices. In addition, there is no autocorrelation in residuals in case of parabolic models fitted to the export of goods from Ukraine to Asia and to the import of goods to Ukraine from the CIS countries and Europe.

Since the model of the export of goods from Ukraine to Europe with parabolic trend component, model of the import of goods to Ukraine from Asia with linear trend component and models of the absolute increases of the rest considered indices correspond to the statistical data according to the F-criterion with the probability $p = 0.95$ we can construct spot and interval forecasts for these models.

Point forecasts of the considered indices for I–IV quarters 2013 are given in Table 5.

The spot forecast of the import of goods to Ukraine from the CIS countries in Table 5 is equal -1028.549 mln USD. Since this index can't be less than 0 we set the value 0.000 in the table. We construct the interval forecasts for the same significance level $\alpha = 0.05$ as we tested the models for correspondence to statistical data according to the F-criterion. We write 0.000 instead of negative values in Table 6 similar to Table 5.

We can see in Table 6, that at the first quarter 2013 the export of goods from Ukraine in general is expected from 5850.204 to 19451.283 mln USD, the export to the CIS countries – from 1865.593 to 6724.536 mln USD, the export to Europe – from 2818.438 to 5167.455 mln USD and the export to Asia – from 1943.011 to 4922.503 mln USD with the probability $p = 0.95$. These results correspond very well to the actual data from the official site of the State Statistics Service of Ukraine: the export of goods from Ukraine in general, to the CIS countries, Europe and Asia is equal to 15911.297, 5285.645, 4525.496 and 4048.870 mln USD respectively. The import of goods to Ukraine in general at the first quarter 2013 is expected from 6286.097 to 22305.342 mln USD, the import from the CIS countries – from 1503.331 to 8462.255 mln USD, the import from the Europe – from 1799.953 to 6905.130 mln USD, the import from Asia – from 4048.723 to 4598.172 mln USD with the probability $p = 0.95$. These results correspond very well to the actual data for the import of goods in general, from the CIS countries and Europe which are equal to 17898.081, 6550.465 and 6038.640 mln USD respectively, and are greater than the actual data for the import of goods from Asia – 3962.068 mln USD.

The export of goods from Ukraine in general is expected from 3535.747 to 18736.953 mln USD, the export to the CIS countries – from 167.588 to 5598.171 mln USD, the export to Europe – from 3198.973 to 5824.345 mln USD and the export to Asia – from 1540.970 to 4870.989 mln USD; the import of goods to Ukraine in general – from 4721.933 to 22625.796 mln USD, the import from the CIS countries – to 6685.849 mln USD, the import from Europe – from 1809.227 to 7515.014 mln USD, the import from Asia – from 4730.618 to 5330.629 mln USD at the second quarter 2013 with probability $p = 0.95$.

Table 5. Spot forecasts of the indices of Ukraine's external trade in goods for 2013

#	Indices	Quarter	Model for forecasting	Index's forecast, mln USD
1	Export of goods from Ukraine in general	I	$\tilde{Y}_{e1} = 3493.141 + 3501.670 \times t - 174.293 \times t^2$	12650.743
		II	$\tilde{Y}_{e1} = 4577.346 + 3501.670 \times t - 174.293 \times t^2$	11136.350
		III	$\tilde{Y}_{e1} = 2061.642 + 3501.670 \times t - 174.293 \times t^2$	5673.460
		IV	$\tilde{Y}_{e1} = 5270.477 + 3501.670 \times t - 174.293 \times t^2$	5586.524
2	Export of goods from Ukraine to the CIS countries	I	$\tilde{Y}_{e2} = 1131.874 + 1468.051 \times t - 75.411 \times t^2$	4295.064
		II	$\tilde{Y}_{e2} = 891.011 + 1468.051 \times t - 75.411 \times t^2$	2882.879
		III	$\tilde{Y}_{e2} = 693.186 + 1468.051 \times t - 75.411 \times t^2$	1362.911
		IV	$\tilde{Y}_{e2} = 1249.719 + 1468.051 \times t - 75.411 \times t^2$	446.479
3	Export of goods from Ukraine to Europe	I	$\tilde{Y}_{e3} = 1230.187 + 429.886 \times t - 15.728 \times t^2$	3992.947
		II	$\tilde{Y}_{e3} = 1869.482 + 429.886 \times t - 15.728 \times t^2$	4511.659
		III	$\tilde{Y}_{e3} = 1439.512 + 429.886 \times t - 15.728 \times t^2$	3929.650
		IV	$\tilde{Y}_{e3} = 1720.691 + 429.886 \times t - 15.728 \times t^2$	4027.335
4	Export of goods from Ukraine to Asia	I	$\tilde{Y}_{e4} = 2326.045 + 640.438 \times t - 33.843 \times t^2$	3432.757
		II	$\tilde{Y}_{e4} = 2643.348 + 640.438 \times t - 33.843 \times t^2$	3205.979
		III	$\tilde{Y}_{e4} = 1829.342 + 640.438 \times t - 33.843 \times t^2$	1780.207
		IV	$\tilde{Y}_{e4} = 2372.104 + 640.438 \times t - 33.843 \times t^2$	1643.516
5	Import of goods to Ukraine in general	I	$\tilde{Y}_{i1} = 461.851 + 4878.439 \times t - 239.099 \times t^2$	14295.719
		II	$\tilde{Y}_{i1} = 3330.021 + 4878.439 \times t - 239.099 \times t^2$	13673.865
		III	$\tilde{Y}_{i1} = 499.629 + 4878.439 \times t - 239.099 \times t^2$	6875.252
		IV	$\tilde{Y}_{i1} = 3703.315 + 4878.439 \times t - 239.099 \times t^2$	5632.517
6	Import of goods to Ukraine from the CIS countries	I	$\tilde{Y}_{i2} = 1157.833 + 2167.909 \times t - 114.289 \times t^2$	4982.793
		II	$\tilde{Y}_{i2} = 804.281 + 2167.909 \times t - 114.289 \times t^2$	2797.038
		III	$\tilde{Y}_{i2} = 417.551 + 2167.909 \times t - 114.289 \times t^2$	349.529
		IV	$\tilde{Y}_{i2} = 1328.831 + 2167.909 \times t - 114.289 \times t^2$	0.000
7	Import of goods to Ukraine from Europe	I	$\tilde{Y}_{i3} = -580.913 + 1606.913 \times t - 77.454 \times t^2$	4352.541
		II	$\tilde{Y}_{i3} = 832.626 + 1606.913 \times t - 77.454 \times t^2$	4662.120
		III	$\tilde{Y}_{i3} = -358.789 + 1606.913 \times t - 77.454 \times t^2$	2211.838
		IV	$\tilde{Y}_{i3} = 1265.419 + 1606.913 \times t - 77.454 \times t^2$	2422.273
8	Import of goods to Ukraine from Asia	I	$\tilde{Y}_{i4} = 644.320 + 216.419 \times t$	4323.447
		II	$\tilde{Y}_{i4} = 1135.077 + 216.419 \times t$	5030.623
		III	$\tilde{Y}_{i4} = 1194.009 + 216.419 \times t$	5305.975
		IV	$\tilde{Y}_{i4} = 1412.558 + 216.419 \times t$	5740.943

Source: Own construction based on the data from the official site of the State Statistics Service of Ukraine.

Table 6. Interval forecasts of the indices of Ukraine's external trade in goods for the significance level $\alpha = 0.05$ for 2013

#	Indices	Quarter forecast of index, mln USD			
		I	II	III	IV
1	Export of goods from Ukraine in general	(5850.204; 19451.283)	(3535.747; 18736.953)	(0.000; 14283.183)	(0.000; 15407.154)
2	Export of goods from Ukraine to the CIS countries	(1865.593; 6724.536)	(167.588; 5598.171)	(0.000; 4510.001)	(0.000; 3954.869)
3	Export of goods from Ukraine to Europe	(2818.438; 5167.455)	(3198.973; 5824.345)	(2442.681; 5416.619)	(2331.232; 5723.438)
4	Export of goods from Ukraine to Asia	(1943.011; 4922.503)	(1540.970; 4870.989)	(0.000; 3666.278)	(0.000; 3794.851)
5	Import of goods to Ukraine in general	(6286.097; 22305.342)	(4721.933; 22625.796)	(0.000; 17015.716)	(0.000; 17199.180)
6	Import of goods to Ukraine from the CIS countries	(1503.331; 8462.255)	(0.000; 6685.849)	(0.000; 4754.650)	(0.000; 3996.127)
7	Import of goods to Ukraine from Europe	(1799.953; 6905.130)	(1809.227; 7515.014)	(0.000; 5443.505)	(0.000; 6108.455)
8	Import of goods to Ukraine from Asia	(4048.723; 4598.172)	(4730.618; 5330.629)	(4980.172; 5631.777)	(5388.940; 6092.945)

Source: Own construction based on the data from the official site of the State Statistics Service of Ukraine.

The export of goods from Ukraine in general, to the CIS countries and Asia is expected to 14283.183, 4510.001 to 3666.278 mln USD, the export to Europe – from 2442.681 to 5416.619 mln USD at the third quarter 2013 with probability $p = 0.95$. The import of goods to Ukraine in general, from the CIS countries and Europe is expected as 17015.716, 4754.650 and 5443.505 mln USD respectively, and the import from Asia – from 4980.172 to 5631.777 mln USD at the third quarter 2013 with the probability $p = 0.95$.

And the export of goods from Ukraine in general is expected as 15407.154 mln USD, the export to the CIS countries – to 3954.869 mln USD, the export to Europe – from 2331.232 to 5723.438 mln USD and the export to Asia – to 3794.851 mln USD; the import of goods to Ukraine in general – to 17199.180 mln USD, the import from the CIS countries – to 3996.127 mln USD, the import from Europe – to 6108.455 mln USD, the import from Asia – from 5388.940 to 6092.945 mln USD at the fourth quarter 2013 with the probability $p = 0.95$.

Conclusions and directions for further studies. Econometric models of the goods export from Ukraine and the import to Ukraine in general, from the CIS countries, European and Asian countries are constructed based on the quarterly data of the State Statistics Service of Ukraine for 2009–2012. All the models were constructed on the values of absolute increases of the corresponding indices of foreign trade in Ukraine as compared with the same quarter of the previous year except models of the export of goods from Ukraine to Europe and the import of goods to Ukraine from Asia. We consider the linear trend component in the model of the import of goods to Ukraine from Asia and the parabolic trend component in the rest models because there is a positive autocorrelation in residuals in case of all other linear trend models. All the constructed models correspond to the statistical data according to the Fisher test for the significance level $\alpha = 0,05$. Also we conclude that there is no autocorrelation in the residuals in case of models fitted to the export of goods from Ukraine to Asia and to the import of goods to Ukraine from the CIS countries, Europe and Asia based on

the Durbin-Watson test. We can make a conclusion neither about the presence, nor the absence of the autocorrelation in residuals in case of models fitted to other indices.

Since the constructed models correspond to the statistical data according to the Fisher test, we constructed spot and interval forecasts for the significance level $\alpha = 0,05$ for them for I–IV quarters of 2013. The constructed forecasts except the import of goods from Asia correspond very well to the actual data from the official site of the State Statistics Service of Ukraine for the I quarter of 2013.

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