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ECONOMIC AND MATHEMATICAL MODELING OF UKRAINIAN METALLURGICAL ENTERPRISES FINANCIAL EQUILIBRIUM

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Annotation: The economic and mathematical model for forecasting the financial equilibrium stability index is based on the example of metallurgical enterprises. The main research method is mathematical gnostic analysis. The forecast of corporate finances balance for Ukraine's metallurgy is made.

Key words: financial equilibrium, stability index, economic-mathematical model, metallurgical enterprises, modeling, forecast.

The database for predicting the stability index of enterprise financial equilibrium is formed. There is financial statements of twelve Ukrainian metallurgical enterprises [4]. This sample is representative. The production of these enterprises is about 30% of Ukraine's metallurgical production in 2018. Let's build an economic-mathematical model. It should describe external factors impact on the stability of metallurgical enterprises financial equilibrium. The standard error of each variant of financial equilibrium modeling is shown in Figure 1.

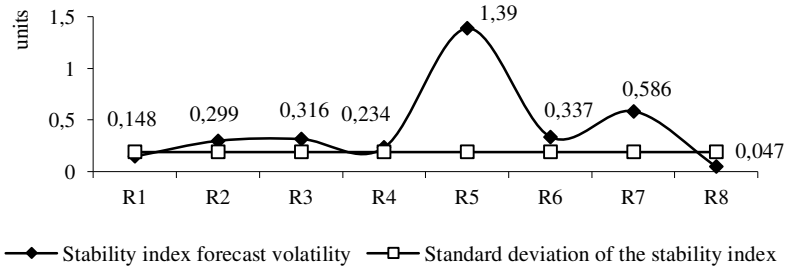

Fig. 1. Variants of Ukraine's metallurgical enterprises financial equilibrium stability index modeling

Source: calculated by the author on the basis of [1, 3, 4]

Nowadays Ukraine's economy is very unstable. Economic fluctuations influence the results of any forecast. The long-term outlook is very variable. The eighth option (R8) is the most statistically valid of all the forecast courses. It has the smallest forecast error. It is substantially less than the volatility of the performance indicator itself. Option (R8) allows forecasting of financial equilibrium stability index for metallurgical enterprises until two years.

Figure 2 shows the structure of external factors influence on the financial equilibrium of metallurgical enterprises.

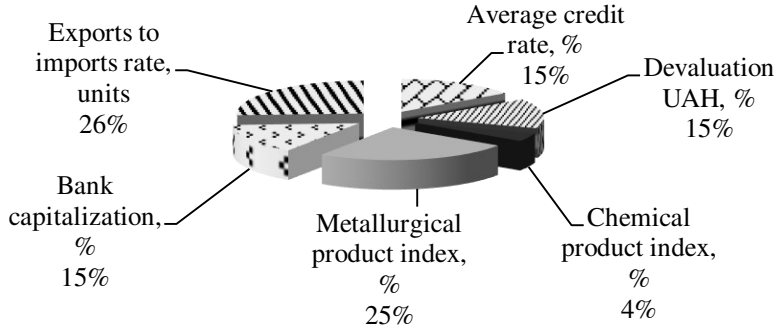

Fig. 2. Parts of external factors in the forecast of metallurgical enterprise financial equilibrium stability index in the short term

Source: calculated by the author on the basis of [1, 3, 4]

In the short term, the financial equilibrium of metallurgical enterprises is most sensitive to monetary transmission impulses. They are transmitted by inflation, interest and currency channels.

Ukrainian metallurgical enterprises are the largest exporters. Therefore, the global market environment is very important for them. Exports of domestic metallurgical products is lower than its imports. Even in the post-crisis 2009 exports of metallurgical products from Ukraine were almost five times higher than imports. Then, as in 2016-2018 trade balance for this product group decreased by 30% compared to 2009. This is due to the wave of decline in metallurgical production in

Ukraine, which began in 2012. Despite the slight growth of the domestic metallurgical industry in 2016-2018, its production volume since 2012 has been restored decreased by a third. However, metallurgical enterprises, as large exporters, have a particular perception of national currency devaluation. It is profitable for them [2, c. 323].

Correlation between external factors and financial equilibrium stability index of Ukraine's metallurgical enterprises is described by the model (1):

$$Y = -0{,}00255 \cdot X_1 - 0{,}00790 \cdot X_2 + 0{,}00189 \cdot X_3 + 0{,}03540 \cdot X_4 + 0{,}00044 \cdot X_5 + 0{,}10758 \cdot X_6 + 0{,}02961 \cdot X_7, \quad (1)$$

де Y – financial equilibrium stability index of a metallurgical enterprise;

X_1 – inflation index;

X_2 – average credit rate;

X_3 – devaluation UAH;

X_4 – chemical product index;

X_5 – metallurgical product index;

X_6 – exports to imports rate;

X_7 – bank capitalization.

Table 1 presents the statistical characteristics of the economic-mathematical model for the short-term forecasting metallurgical enterprises financial equilibrium stability index.

Table 1

Statistical characteristics of the economic-mathematical model for the short-term forecasting Ukraine's metallurgical enterprises financial equilibrium stability index, %

Factors	Coeffs	Std (C[k])	Mean (x[,k])	Mean (Cx[,k])	Probability value
1. Inflation index, (X_1)	-0.02613	0.00242	114.58	-2.99366	0.000002
2. Average credit rate, (X_2)	-0.05744	0.00670	17.65	-1.01397	0.000013
3. Devaluation UAH, (X_3)	-0.00844	0.00115	15.15	-0.12784	0.000045
4. Chemical product index, (X_4)	0.00204	0.00064	92.64	0.18865	0.011065
5. Metallurgical product index, (X_5)	0.01414	0.00124	95.36	1.34858	0.000001
6. Exports to imports rate, (X_6)	0.05161	0.00624	16.31	0.84165	0.000017
7. Bank capitalization, (X_7)	0.43464	0.04817	4.16	1.80841	0.000008

Source: calculated by the author on the basis of [1, 3, 4]

Let's describe the parameters of the model (1). They point to important factors for shaping the stability of metallurgical enterprise financial equilibrium. There are: kind of interaction with the financial sector, development of economic relations with chemical industry, macroeconomic stabilization, state of the economy in both the domestic and global metallurgical products market.

The quantitative external factors impact on the stability of metallurgical enterprises financial equilibrium under other factors invariance is characterized by the following data:

1) an increase in inflation of 1% causes a decrease in the financial equilibrium stability index of the metallurgical enterprise by an average of 0.02613. There is

some cost inflation. Increasing the cost of production is mainly due to the rise in price of energy;

2) if the average credit rate rises by 1%, then the financial equilibrium stability index of some metallurgical enterprise will go down by about 0.05744. A high average credit rate puts pressure on the company current solvency and profitability;

3) depreciation UAH against USD by 1% causes an increase in the financial equilibrium stability index of some metallurgical enterprise by an average of 0.00844. Inflation is beneficial for domestic exporters as their income rises;

4) production increasing in chemical industry has got a positive effect on financial equilibrium stability of metallurgy. Its index increases on the average by 0.00204 with each percentage grows in chemical products;

5) expansion of metallurgical production by 1% leads to some increase of financial equilibrium stability index by about 0.01414;

6) if metallurgical products exports is exceed over imports per unit, then the financial equilibrium index of the exporting producer will increase on the average by 0.05161;

7) the metallurgical enterprise financial equilibrium stability index increases on the average by 0.43464 with every percent increase of Ukraine's banking system capitalization level.

The probability of the null hypothesis is low (less than 0.02). This means its failure. Therefore, the hypothesis of model (1) is valid.

The adequacy of the forecast results is confirmed by their synchronicity with actual financial equilibrium stability index of metallurgical enterprises in 2007-2018 (Fig. 3).

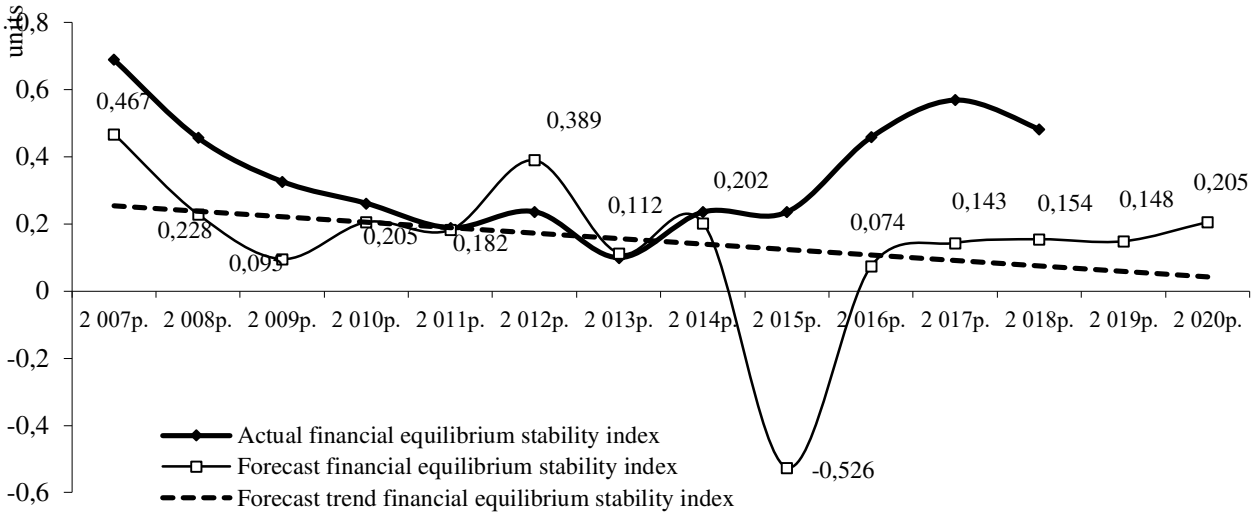

Fig. 3. Dynamics of metallurgical enterprises financial equilibrium stability index in Ukraine during 2007-2018 and its forecast for 2019-2020

Source: calculated by the author on the basis of model (1).

The crisis index of stability of financial equilibrium index of metallurgical enterprises attracts the greatest attention. It was forecast in 2015 given the depth of the Ukrainian economy's decline. However, there was no decline in metallurgy. Its financial potential is obviously strong. After all, it withstood the impact of external shocks. It is likely that the inflation surge in reality was more than offset by the expected increase in income from the devaluation of the Ukrainian currency. This fact is in favor of model (1). It reflected some probable threat. Its implementation depends on the quality and perfection of enterprise management. This is manifested as the adequacy and effectiveness of the decisions taken to reduce or avoid the negative impact of external threats. The success of overcoming obstacles depends not only on the use of opportunities for sustainable development. Enterprise's active participation in the formation of prerequisites for their occurrence is also required. This is especially important in managing the sustainable development of metallurgical enterprises. We see a decrease in the stability of the financial equilibrium in Ukraine's metallurgy. Therefore, the general financial equilibrium of the leading domestic metallurgical enterprises is characterized by a stable form of its negative phase.

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