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Аннотация. На основе существующей практики управления ресурсным потенциалом предприятия определены приоритетные классификационные признаки группировки ресурсов с позиции модернизации: форма привлечения в хозяйственный оборот, степень распространения ресурса, его хозяйственная значимость. На основе данных признаков всю совокупность ресурсов предприятия, составляющих ресурсный потенциал структурировано в виде матрицы и обосновано методические подходы к их экономической оценке.

Ключевые слова: группировка ресурсов предприятия, возможные, перспективные, используемые ресурсы, методы экономической оценки ресурсов предприятия.

Summary. On the basis of existent practice in enterprise management resource potential were defined the priority classification signs for resources groupment from the position of modernization: form of bringing in an economic turn, measure of resource distribution, its economic meaningfulness. On the basis of these signs all aggregate enterprise resources, were structured as a matrix and grounded the methodical approach for its economic evaluation.

Keywords: groupment of enterprise resources, possible, perspective, in-use resources, methods of economic evaluation of enterprise resources.

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COMPLEX ANALYSIS OF BRANCH TRENDS OF METALLURGICAL ENTERPRISES' COMPETITIVENESS

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Розроблено інструментарій комплексної оцінки та аналізу конкурентоспроможності підприємств та галузевих тенденцій їх розвитку з використанням сучасного інструментарію економіко-математичного моделювання статичних і динамічних процесів на основі методів економетричного моделювання та багатовимірного статистичного аналізу. У статті представлена модель комплексного просторово-динамічного дослідження галузевих тенденцій розвитку рівня конкурентоспроможності металургійних підприємств.

Ключові слова: конкурентоспроможність, комплексне просторово-динамічне дослідження, еластичність, індикатор, панельні дані.

Formulation of the problem and its relation to scientific and practical tasks. Investigation of the general state of enterprise's competitiveness suggests the necessity to consider it as a complex polycriterial category that reflects the enterprise capacity to use effectively its existing potential (financial, industrial, scientific, technical, investment, innovation, employment, etc.) for ensuring the continued growth and implementation of strategic alternatives for development of competitive advantages. Today the most urgent issues of complex approach to assessing the enterprises' competitiveness is the development of complex economic and mathematical models which makes possible to estimate objectively the level of enterprises' competitiveness and increase the validity and effectiveness of management decisions.

According to the "Global Competitiveness Report" for 2009-2010, Ukraine ranked 82-th position among 133 countries and has dropped by 10 points over the previous period, and in 2010-2011 it occupied the 89-th place, i.e. decreased by another 7 positions. It confirms the relevance of the research [1].

To improve an unfavorable situation in Ukraine, special attention should be given to increasing the enterprises' competitiveness of the branches that form the Ukrainian industrial sector, in particular iron and steel industry. It is one of the strategic components of national output, it determines the state of socio-economic development of Ukraine and provides foreign exchange revenues to our state (volume of metallurgical products in total export of Ukraine in 2009 amounted to 31.7% and in 2010 - 33,2% of total exports) [2].

Analysis of recent research and publications. Significant contribution to research problems of assessing the level of competitiveness and its increase was done by such native and foreign scientists – economists as V.V. Arestenko, G.L. Azoyev [3], L.V. Balabanova, L.E. Dovgan, R.A. Fathutdynov [4], Y.B. Ivanov, O.I. Kondratyuk, M.O. Kizim, E.V. Krikavskiy [5], M.D. Magomedov, M.Porter [6], A.E. Voronkova [7] and others.

Unresolved parts of the problem. However, today research on competitiveness is isolated in nature and, the most important, doesn't cover enough the economic aspects, nature and mechanisms of industrial enterprises' competitiveness depending on branch orientation and regional distribution. The actual problem is the objective estimation of complex enterprises' competitiveness, based not on expert reviews, but on complex methodology that takes into consideration the objective data of financial and economic activity.

That's why the ***purpose*** of this article is to develop tools for complex assessment and analysis of the enterprises' competitiveness and industry trends in their development by using modern tools of economic-mathematical modeling of static and dynamic processes based on econometric modeling methods and multivariate statistical analysis.

Main body. This paper proposes the model of complex spatial and dynamic study of industry trends of metallurgical companies' competitiveness level; its algorithm is presented in Fig. 1. The model contains a set of interconnected modules. Consider their content and objectives.

Module 1. Formation of the research information space. This module includes searching, collecting and processing of data information space according to the main areas of the enterprise.

The purpose of this module is the formation of a representative statistical database of research. On the basis of the annotated analysis of the literature [3, 4 and others] it is found that the most important for the study of competitiveness level are the following areas: the enterprise production, financial development of the company, the effectiveness of marketing and promotions, efficiency of the company labor potential, investment and innovation efficiency, position on the stock market, competitiveness of products. Indicators that evaluate the analyzed local areas best of all are selected by the logical method based on the analysis of indicators used in existing methods and techniques. While forming the information space of parameters they were tested not to be interrelated and interdependent. Also it was necessary to meet the general requirements put forward to information space, namely:

1) unique of indicators, lack of redundancy;

2) completeness - the possibility of adequate description of various processes, facts, events of the subject that is studied by using these indicators;

3) reliability – the correspondence of the selected items of semantic information to their real value;

4) consistency – lack of homonymy.

Also it was taken into account the possibility of calculating the indicators by using the available information concerning the financial activities of metallurgical enterprises.

Module 2. Complex spatial and dynamic assessment of the enterprises' competitiveness. The study aim is the calculation of the integral rating indicators for local components of competitiveness and the overall level of enterprises' competitiveness [8]. The algorithm of the integral taxonomic evaluation method is presented in Fig. 2.

The first step is the matrix formation of output data. As the indicators of competitiveness are non-uniform, the second step involves the standardizing of their values by the formula:

$$z_{ij} = \frac{x_{ij} - \overline{x}_j}{S_j}, \qquad (1)$$

where j = 1, 2, ..., m; $\overline{X}_j$ – average value of the j-th index; S_j – standard deviation of the j-th index; Z_{ij} – standardized value of the j-th index for the i-th company.

Module 1. Formation of the reaearch information space

Module 2. Complex spatial and dynamic assessment of the enterprises' competitiveness

Stage 1.
Models of complex local indicators of competitiveness

Stage 2.
Models which estimates overall level of enterprises' competitiveness

Stage 3.
Analysis of spatial and dynamic trends in the enterprises' competitiveness

Module 3. Analysis of the competitive environment of the branch enterprises

Stage 1.
Econometric models of panel data assessment of local indicators influence on overall level of competitiveness

Stage 2.
The selection and specification of the model

Stage 3.
The analysis of industry characteristics of enterprises' competitiveness

Analysis of the impact of environmental factors on the level of enterprises' competitiveness

Analysis of the elasticity of competitiveness indicators for each company and the industry on the whole

Module 4. Formation of management decisions and choice of competitive strategies of metallurgical enterprises

Stage 1.
The general strategy of increasing the industry's competitiveness

Stage 2.
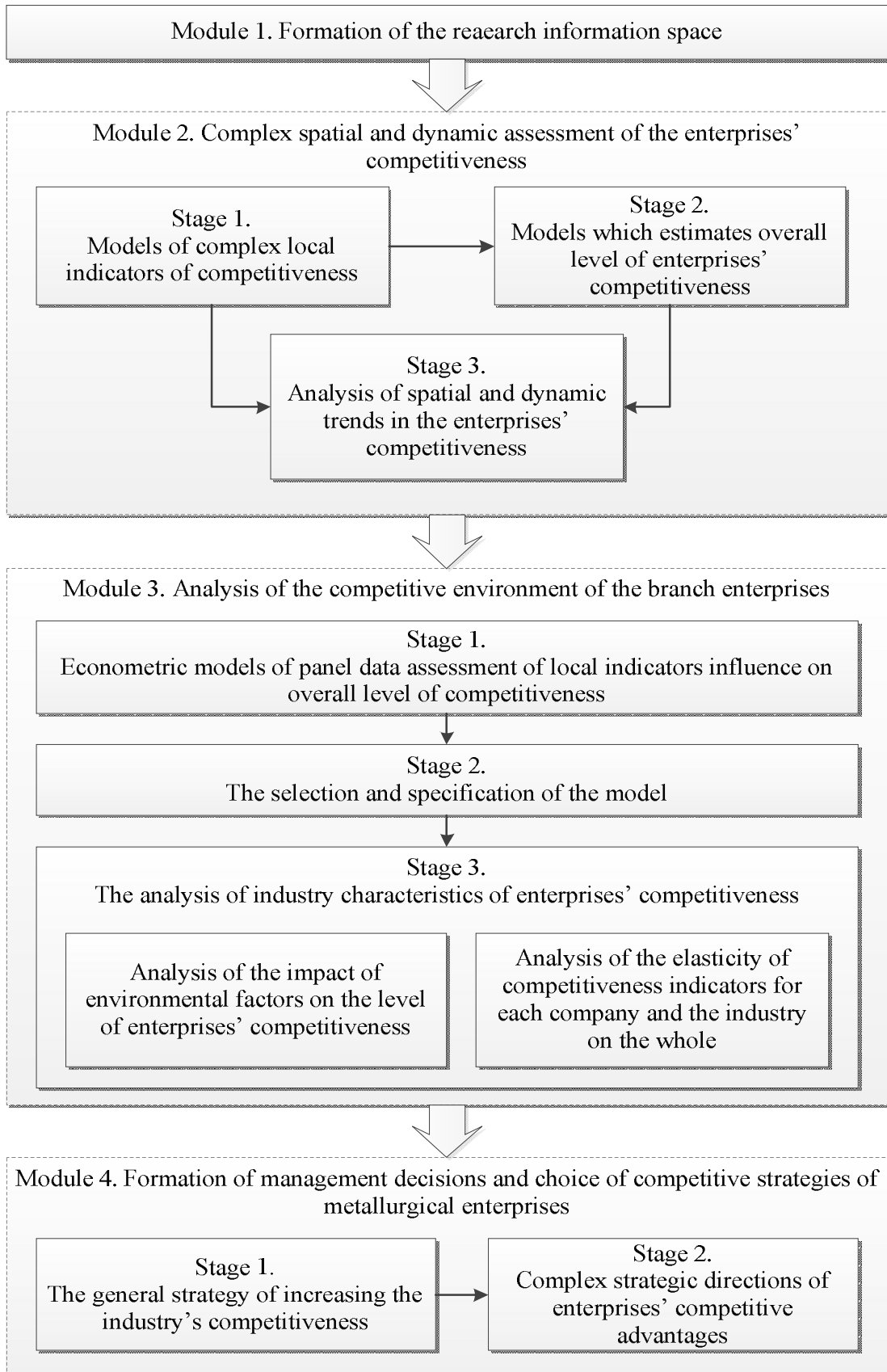Complex strategic directions of enterprises' competitive advantages

Fig. 1 - Model of complex spatial and dynamic research of industry trends in the enterprises' competitiveness development
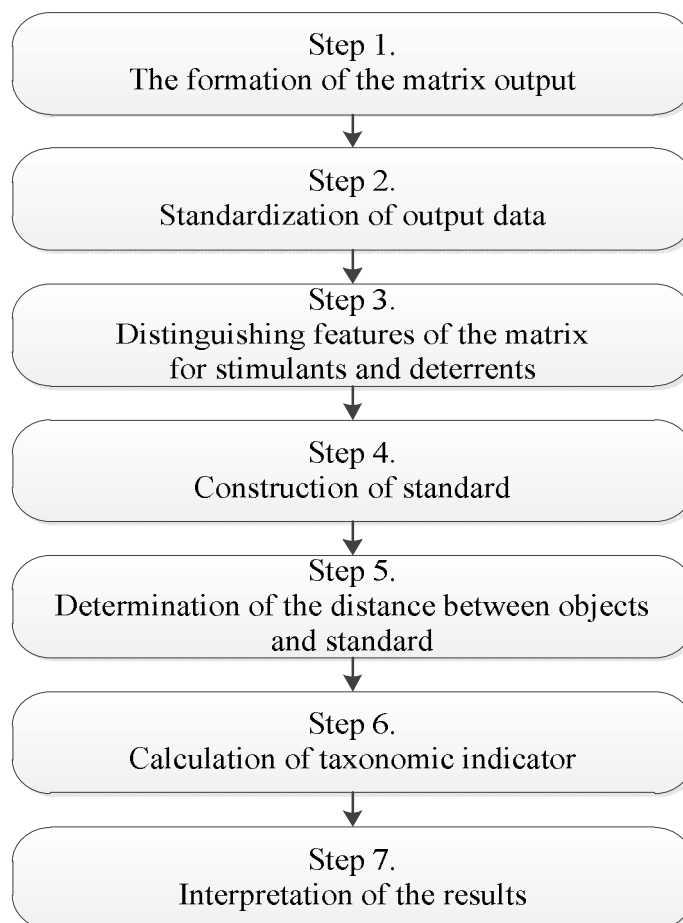
Fig. 2 - The algorithm of realization of integral taxonomic estimation method

The third step carried out the differentiation characteristics of the observations matrix on stimulants and deterrents. The basis for characteristics division into two groups is the impact of each indicator on the level of enterprises' competitiveness. Characteristics that have positive, stimulating effect on competitiveness level, are stimulant, others are deterrents. Thus, such parameters as depreciation of fixed assets, the rate of defects, number of claims, the rate of staff turnover, loss of working hours per employee, etc. were classified and determined as deterrents. Next steps (4 and 5) provide for the construction of standard's point and determination of Euclidean distance between objects and the standard.

Step 6 involves direct calculation of the integral taxonomic indicator of the competitiveness level by the formula [8]:

$$I_i = 1 - \frac{C_{i0}}{C_0}, \qquad (2)$$

where $C_0 = \overline{C_0} + 3 \times S_0$; $\overline{C_0} = \frac{1}{w} \sum_{i=1}^{w} C_{i0}$;

$$S_0 = \sqrt{\frac{1}{w} \sum_{i=1}^{w} \left(C_{i0} - \overline{C_0}\right)^2} .$$

According to the selected areas of enterprises' competitiveness research the following local integral indicators were calculated: I_1 –competitive of products, I_2 – production efficiency of the enterprise; I_3 – enterprise's financial development; I_4 - the effectiveness of marketing and promotions, I_5 - the effectiveness of labor potential of the enterprise; I_6 – efficiency of investment and innovation activity; I_7 – position on the stock market. Results of calculated complex indicators of overall level of metallurgical enterprises' competitiveness in the dynamics for 6 years and the main statistical characteristics of the research of metallurgical enterprises are presented in Tab. 1.

Analysis of the results of the enterprises' competitiveness assessment makes it possible to distribute the analyzed metallurgical enterprises with a high, medium and low level of competitiveness.

Complex general integral indicators of metallurgical enterprises' competitiveness level (I) in Ukraine

Enterprises	Years					
	2005	2006	2007	2008	2009	2010
"Azovstal" Mariupol Metallurgical Works", JSC	0,5707	0,6707	0,7753	0,4591	0,5583	0,5748
"ArcelorMittal Krivoy Rog", OJSC	0,6569	0,6770	0,7932	0,6056	0,7793	0,7066
"Ilyich Mariupol Metallurgical Works", JSC	0,6237	0,5699	0,6938	0,5433	0,6053	0,6416
"Dzerzhinsky Dnepropetrovsk Metallurgical Works", OJSC	0,5580	0,6172	0,6550	0,4005	0,4671	0,4840
"Enakievo Metallurgical Works", JSC	0,4463	0,5119	0,6076	0,4471	0,4776	0,3691
"Dniprospetsstal" "Kuzmin Electrometallurgical Works", JSC	0,4370	0,5443	0,6241	0,3292	0,4503	0,5088
"Petrovsky Dnepropetrovsk Metallurgical Works", JSC	0,3006	0,2777	0,4190	0,1956	0,3564	0,3027
"Donetsk Metal Rolling Works", JSC	0,5903	0,5346	0,5435	0,3847	0,5294	0,5214
"Donetsk Metallurgical Works", JSC	0,4836	0,4790	0,5289	0,3987	0,4533	0,4873
"Kuibishev Kramatorsk Metallurgical Works", JSC	0,0701	0,0574	0,0420	0,1219	0,0776	0,1029
"Metallurgical Works "Zaporizhstal", JSC	0,7044	0,6358	0,7649	0,5674	0,6006	0,6753
"Alchevsk Metallurgical Works", JSC	0,5597	0,5657	0,5854	0,4450	0,4294	0,4476
Statistical characteristics						
Average	0,5001	0,5118	0,5861	0,4082	0,4820	0,4852
Standard deviation	0,1667	0,1706	0,1954	0,1361	0,1607	0,1617
Coefficient of variation	33,33	33,33	33,33	33,33	33,33	33,33
The minimum value	0,0701	0,0574	0,0420	0,1219	0,0776	0,1029
The maximum value	0,7044	0,6770	0,7932	0,6056	0,7793	0,7066
Range of variation	0,6344	0,6195	0,7513	0,4837	0,7016	0,6037

The value of the integral complex general index close to 1 indicates a high level of competitiveness. Thus, the companies with high levels of competitiveness are "ArcelorMittal Krivoy Rog", OJSC, Ilyich "Mariupol Metallurgical Works", JSC, "Metallurgical Works "Zaporizhstal". On the other hand "Kuibishev Kramatorsk Metallurgical Works", JSC has the lowest level of competitiveness. The results of spatial and dynamic evaluation of competitiveness level are the basis for the formation of management decisions for the development of strategic programs adapted to enterprises with different competitiveness level.

Module 3. Analysis of the competitive environment of the branch enterprises. The aim of the module is the formation of general trends in the particular branch, and the selection of specific features for each enterprise. The first stage involves the construction of econometric panel data models [9, 10] for assessment the impact of the local indicators impact the overall enterprises' competitiveness. The choice of these mathematical tools for assessment, analysis and prediction of enterprises' competitiveness and the competitive environment is determined by the following features:

- the use of panel data for construction of enterprises' competitiveness assessment models (including sectoral orientation), which combine a spatial data type and data type of time series, the use of panel data [9, 10] can solve the problem of expanding the information base;

- the use of panel data increases the efficiency of parameter estimates in comparison with estimation based on specific models of temporary or variational series;

- the advantage of models derived from panel data is the solution of the missed data problem in the model. When using panel data the robust estimates of model parameters can be obtained even with the missing data. The problem of missing data is particularly serious if the variable excluded from the model correlates with the variable included in the model factors;

- panel data allow us to build more flexible and meaningful models and analyze individual differences in enterprises' competitiveness levels which is impossible with models based in particular on spatial data.

One of the problems of panel data use is the problem of choosing the type of model (ordinary regression, fixed or random effect). To select the model specification between the fixed and random effects we apply Hausman test, which is calculated by the following formula:

$$H = (\beta_{FE} - \beta_{RE})'(Var(\beta_{FE}) - Var(\beta_{RE}))^{-1}(\beta_{FE} - \beta_{RE}), \qquad (3)$$

where β_{FE} – the vector of model's estimates with fixed effects;

where β_{RE} - the vector of model's estimates with random effects;

$(Var(\beta_{FE}) - Var(\beta_{RE}))^{-1}$ - covariance matrix estimation $(\beta_{FE} - \beta_{RE})$.

If $H < X^2_{estimated}$ we choose the model with random effects, if $H > X^2_{estimated}$ we choose the model with fixed effects.

For panel data model assessment of local indicators on overall enterprises' competitiveness H = 15.05, $X^2_{estimated}$ = 14.07. Thus, the results justify the choice of models with fixed effects for the analysis. Model panel data with fixed effects estimation of enterprises' competitiveness is shown in Fig. 3.

Dependent Variable: I?				
Included observations: 6				
Number of cross-sections used: 12				
Total panel (balanced) observations: 72				
White Heteroskedasticity-Consistent Standard Errors & Covariance				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
I1?	0.116919	0.065522	2.784423	0.0301
I2?	0.256581	0.061560	4.167948	0.0001
I3?	0.264150	0.076013	3.475051	0.0010
I4?	0.112658	0.050450	2.233063	0.0298
I5?	0.291435	0.052817	5.517818	0.0000
I6?	0.219351	0.086702	2.529945	0.0144
I7?	0.375466	0.101608	3.695235	0.0005
Fixed Effects				
_P01--C	-0.156501			
_P02--C	-0.213058			
_P03--C	-0.202277			
_P04--C	-0.154838			
_P05--C	-0.147343			
_P06--C	-0.163942			
_P07--C	-0.179893			
_P08--C	-0.137778			
_P09--C	-0.145576			
_P10--C	-0.178220			
_P11--C	-0.194998			
_P12--C	-0.156671			
R-squared	0.937748	Mean dependent var		0.495556
Adjusted R-squared	0.916606	S.D. dependent var		0.175359
S.E. of regression	0.050640	Sum squared resid		0.135914
F-statistic	133.0636	Durbin-Watson stat		2.850113
Prob(F-statistic)	0.000000			

Fig. 3 - Model panel data assessment of local indicators impact on overall enterprises' competitiveness

It has the following general form:

$$I = \mu_i + 0,12 \times I_1 + 0,26 \times I_2 + 0,26 \times I_3 + 0,11 \times I_4 + 0,29 \times I_5 + 0,22 \times I_6 + 0,37 \times I_7, (4)$$

where μ_i - fixed effect, reflecting the influence of environmental factors on the overall competitiveness of enterprises.

The resulting model is adequate for the coefficient of determination ($R^2 = 0,94$) and Fisher criterion (F = 133,06). Estimates of parameters are statistically significant by Student's criterion ($t_{ai} > t_{кр} = 1,99$).

The value of the fixed effects panel data model assessment of local indicators of overall competitiveness of metallurgical enterprises in Ukraine are presented in Fig. 4.
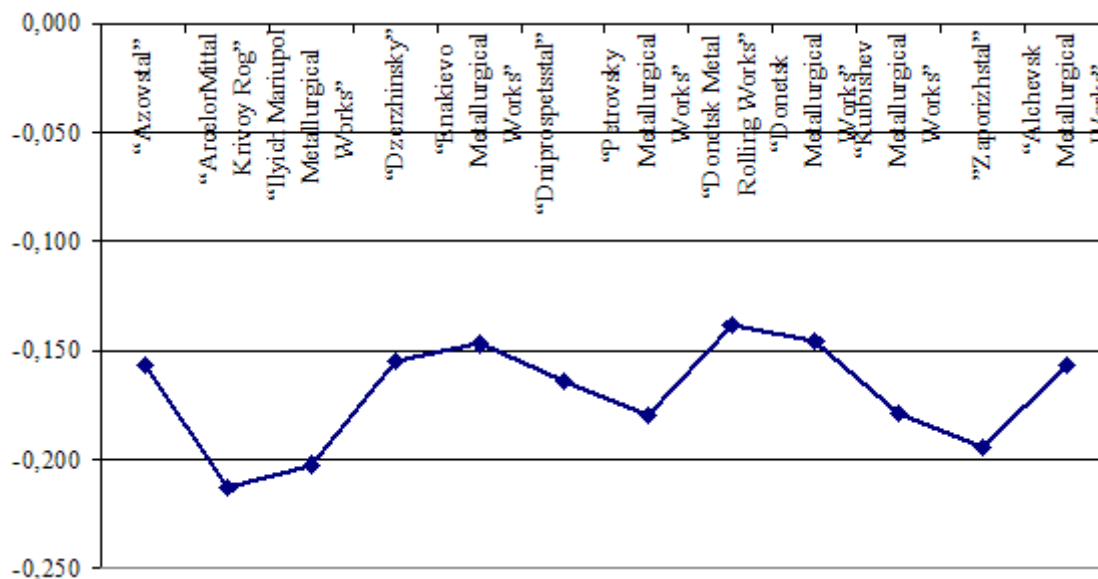

Fig. 4 - Graph of values of fixed effects of panel data model research of metallurgical enterprises' competitiveness

According to the obtained panel data model we can conclude that:

- most of all the enterprises' competitiveness depends on the position in the securities market, the efficiency of labor potential, financial development and efficiency of production activities. This is explained by the fact that the stock market solves the problem of lack of money and of real source of its attraction. The level of investment attractiveness depends on the enterprise position on the stock market.

- In order to increase the metallurgical plant competitiveness level it is vital to improve its working capacity. It can be achieved due to innovation in the workplace and the use of advanced technology by management staff.

- In order to increase the enterprises' competitiveness it is necessary to increase productivity, profitability of production to improve the plant and equipment through their reconstruction and modernization.

To analyze the sectoral features of the enterprises' competitiveness we propose to analyze the elasticity of indicators competitiveness for each company and the industry on the whole. This analysis will determine the degree of change in a complex integral index of enterprises' competitiveness in case of the appropriate local integral index change. It is known that elasticity is the value used to determine the response of one variable on another, i.e. this is percentage by which one variable changes in response to a one percent change in another variable. Elasticity of local indicators of competitiveness for the industry on the whole is presented in Tab. 2.

An average increase of production activities efficiency for the analyzed years by 1% leads to an increase in complex integral index of competitiveness by 0,14%. The rate increase of financial development by 1% will lead to the increase of complex integral index by 0,22%.

Elasticity of competitiveness indicators for industry

Local indicators	Years						Mean
	2005	2006	2007	2008	2009	2010	
Competitive of products (I_1)	0,09	0,08	0,07	0,12	0,08	0,08	0,08
The effectiveness of production activity (I_2)	0,19	0,16	0,12	0,14	0,11	0,10	0,14
Financial development (I_3)	0,23	0,21	0,18	0,20	0,24	0,25	0,22
The effectiveness of sales (I_4)	0,09	0,07	0,06	0,07	0,11	0,06	0,08
The effectiveness of labor potential (I_5)	0,20	0,24	0,21	0,25	0,26	0,31	0,24
The effectiveness of investment and innovation (I_6)	0,19	0,21	0,18	0,28	0,19	0,18	0,20
Position on the securities market (I_7)	0,38	0,39	0,34	0,42	0,39	0,40	0,38

The improvement of working capacity by 1% leads to an increase in complex integrated parameter by 0,24%, the increase of investment and innovation would increase complex integral index by 0,2%. In its turn, the improvement of enterprise position indicator on the stock market by 1% leads to the increase in complex integrated parameter of competitiveness by 0,38%.

Elasticity of indicators for each of the analyzed metallurgical companies is presented in Tab. 3.

Analysis of indicators elasticity of metallurgical enterprises' competitiveness in Ukraine

Enterprises	Indicators of competitiveness						
	I_1	I_2	I_3	I_4	I_5	I_6	I_7
"Azovstal" Mariupol Metallurgical Works", JSC	0,07	0,15	0,16	0,08	0,20	0,22	0,37
"ArcelorMittal Krivoy Rog", OJSC	0,06	0,09	0,20	0,07	0,19	0,19	0,49
"Ilyich Mariupol Metallurgical Works", JSC	0,05	0,13	0,24	0,08	0,20	0,26	0,37
"Dzerzhinsky Dnepropetrovsk Metallurgical Works", OJSC	0,09	0,16	0,20	0,06	0,25	0,16	0,37
"Enakievo Metallurgical Works", JSC	0,10	0,12	0,22	0,07	0,27	0,20	0,34
"Dniprospetsstal" "Kuzmin Electrometallurgical Works", JSC	0,07	0,15	0,25	0,08	0,28	0,17	0,34
"Petrovsky Dnepropetrovsk Metallurgical Works", JSC	0,11	0,13	0,23	0,09	0,27	0,21	0,55
"Donetsk Metal Rolling Works", JSC	0,10	0,17	0,19	0,08	0,24	0,15	0,33
"Donetsk Metallurgical Works", JSC	0,11	0,11	0,24	0,08	0,26	0,16	0,35
"Kuibishev Kramatorsk Metallurgical Works", JSC	0,21	0,31	0,49	0,18	0,35	0,72	1,00
"Metallurgical Works "Zaporizhstal", JSC	0,08	0,12	0,25	0,06	0,27	0,22	0,31
"Alchevsk Metallurgical Works", JSC	0,07	0,15	0,21	0,07	0,25	0,19	0,36

Module 4. Formation of management decisions and choice of competitive strategies of metallurgical enterprises. This module consists of two successive stages – formation of common strategies enhance for the industry competitiveness and the set of strategic directions for development of enterprise competitive advantage. Within

this module the decisions are taken depending on the level of enterprises' competitiveness and its strong and weak points. Also we found which company performance should be given the most attention. It will form priority strategies for increasing the enterprises' competitiveness and improve market position in the future.

Conclusions. The model of complex analysis of sectoral trends of metallurgical enterprises' competitiveness development will make it possible to assess adequately and systematically the level of analyzed enterprises competitiveness. It allows the management to identify the factors with the largest reserves increase for competitiveness and thus to improve the quality of management decisions on formation, selection and implementation of strategic alternatives for development of competitive advantages in conditions of negative factors of external and internal environment, taking into account the totality of interrelated economic and financial processes. In addition, complex aggregated analysis based on the results of industry trends modeling in the enterprises' competitiveness will help the public authorities to determine the overall competitive advantage in managing competitiveness of both individual enterprises and industries and the national economy, thus reducing the risk of its decline due to the changes in the conditions of internal market and world markets.

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Аннотация. Разработан инструментарий комплексной оценки и анализа конкурентоспособности предприятий и отраслевых тенденций их развития с использованием современного инструментария экономико-математического моделирования статических и динамических процессов на основе методов эконометрического моделирования и многомерного статистического анализа. В статье представлена модель комплексного пространственно-динамического исследования отраслевых тенденций развития уровня конкурентоспособности металлургических предприятий.

Ключевые слова: конкурентоспособность, комплексное пространственно-динамическое исследование, эластичность, индикатор, панельные данные.

Summary. Tools for complex assessment and analysis of the enterprises' competitiveness and industry trends in their development by using modern tools of economic-mathematical modeling of static and dynamic processes based on econometric modeling methods and multivariate statistical analysis are developed. The model of complex spatial and dynamic study of industry trends of metallurgical companies' competitiveness level is presented in this article.

Keywords: competitiveness, complex spatial and dynamic study, elasticity, indicator, panel data.