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COMPLEX OF MANAGEMENT MODELS OF THE ENTERPRISE COMPETITIVENESS FOR STEEL INDUSTRY IN THE CURRENCY INSTABLE ENVIRONMENT

The complex of models of metallurgical enterprises competitiveness management in unstable currency environment is built based on the metallurgical enterprises competitiveness level evaluation and industry trends of their development. The degree of the exchange rates impact on the metallurgical enterprises competitiveness by the methods of reduction, integrated assessment models, and econometric panel data is estimated. The exchange rates dynamics is investigated based on fractal models and forecasts are made by using a wide range of forecasting models. The system of exchange rate factors is improved and their impact on the metallurgical enterprises competitiveness is assessed on the bases of an integrated evaluation, econometric dynamic models and fuzzy sets.
JEL: C13; C15; C51; C63; L61

1. Introduction

The intensification of the international competition in the market of steel products, the unstable political situation in Ukraine, the sharp devaluation of the national currency, the European integration processes, the tense trade and economic relations with Russia which is one of the main suppliers of metallurgical enterprises production generate a wide range of both competitive opportunities and threats to metallurgical enterprises competitiveness.

Special attention should be given to increasing the enterprises' competitiveness of the branches that form Ukrainian industrial sector, in particular metallurgical industry. So far

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since metallurgical industry is export-oriented and provides more than 30% of foreign exchange earnings to country, and therefore may suffer significant losses due to unfavorable exchange rate dynamics, the research of precisely those environmental factors that affect the formation of foreign exchange rate is of primary importance.

The basis of metallurgical enterprises competitiveness in volatile currency environment is determination of the mechanisms of the exchange rates effect on the enterprises competitiveness and evaluation of such effects. Currency environment is a set of environmental factors, which affect the exchange rates state and their change over time. Enterprises cannot influence the exchange rates changes, but can react to such changes. Thus, the determination of currency environment impact degree on the enterprises competitiveness made possible to conclude that exchange rates changes affect the metallurgical enterprises competitiveness both negative and positive.

Therefore, the hryvnia devaluation allows metallurgical enterprises to receive additional income when they exchange the foreign currency, which has risen, into the national one, which has cheapened. At the same time hryvnia devaluation in the short term leads to higher prices for imported resources, rise in prices of foreign advanced technology, the growth of receivables and in the long term leads to the fall in production and sales.

2. Literature review

The problem of the enterprises competitiveness is investigated by such scientists as G. Azoev (1996) [0], P. Belenky (2007) [3], A. Voronkova (2009) [27], Y. Ivanov (2003) [0], O. Parshina (2008) [17], M. Porter (2008) [18], O. Tishchenko (2003) [0], A. Trydid (2002) [26], A. Wint (2003) [28], R. Fathutdinov (2000) [10] and others. The problems of foreign exchange rates influence on the competitiveness are reflected in the papers of J. Belinska (2009) [4], O. Bereslavska (2009) [5], V. Danich (2004) [8], A. Zadoya (2009) [29], F. Zhuravka (2006) [30] and others. However, foreign approaches to enterprise competitiveness assessment require adaptation to the characteristics of domestic economic entities. The actual problem is the reliable assessment of the metallurgical enterprises competitiveness, which is based on objective data of their financial and economic activity and in view of exchange rates influence are studied in papers by Ambastha A., Momaya K. (2004) and Belenky P. (2007). Not enough attention is paid to analysis of the exchange rates dynamics; there is a shortage of methods of quantification of its impact on the metallurgical enterprises competitiveness. The approach to assessing the exchange rates influence on the metallurgical enterprises competitiveness is improved. The main feature of this approach is the use of panel data models that makes possible to quantify the degree of the exchange rates influence on the metallurgical enterprises competitiveness, to analyze industry trends of enterprises competitiveness and to form alternatives of metallurgical enterprises competitiveness in terms of exchange rates changes are considered in work by Goncharova T.S. (2008).

3. Common fundamentals

The complex of models of management decisions formation for ensuring the enterprises competitiveness in volatile currency environment is proposed with the aim of determining the currency environment impact on the metallurgical enterprises competitiveness and management of competitiveness in volatile currency environment (Brumnik, R., Klebanova, T., Guryanova, L., Sergienko, O., Kavun, S., Nepomnyaschiy, V., 2014; Depperu D., Cerrato D., 2005; Kavun, S., Čaleta, D., Vršec, M., Brumnik, R., 2013). Managing competitiveness in the work presented in the form of the convoy:

$$Upr = \{R,\ P,\ S,\ K\}, \tag{1}$$

where R is a set of available resources for enterprise competitiveness spheres; (development potential); P is a set of influence factors of environment; S is a set of available strategies of enterprise development; K is a set of criteria for achieving development goals.

Under this model, the formation of competitiveness management strategies is made, namely:

1) development strategy, which provides timely develop orientations of the company depending on the state and trends of its development, the effectiveness of which is determined by combined expected results;

2) recognition of situations strategy, which involves the development of information and mathematical tools of evaluation, analysis and forecasting of external and internal environment, efficiency of which is determined by the degree of reliable quality information in terms of threats;

3) situations management strategy, which involves the formation of complex solutions which are adequate to the situation and aimed at supporting sustainable enterprise development, localization of negative trends, crisis response, the effectiveness of which is determined by the degree of its utility. The purpose of this model is the choice of alternatives that meet the conditions of effectiveness.

This complex of models is shown in Fig. 1. Let us consider in more detail the implementation of each modules and models, which are presented in Fig. 1.

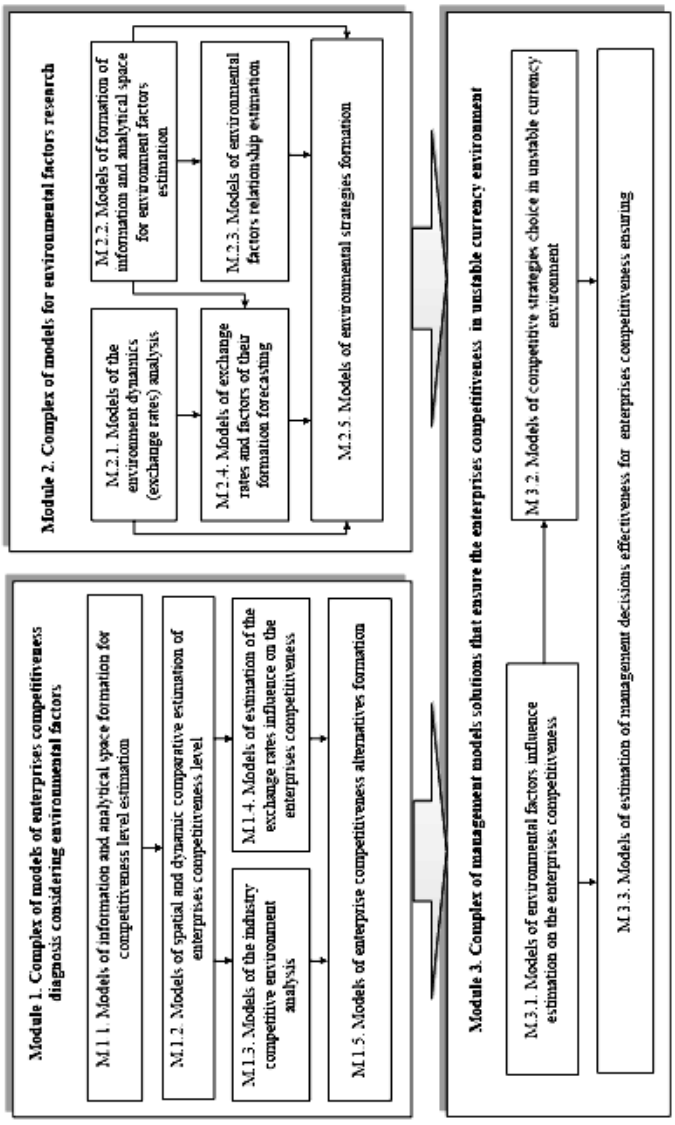
Consequently, the general optimal task of the competitiveness management is:

$$\begin{aligned}
&\int_0^T M_X[F(R_s, P_i)]dt + M_X[(\bar{I}_{iT} - I_{iT})] \to \min \\
&R_S \le f(\{I_{k_it}\}); \\
&P_i \le f(\{F_{it}, E_{it}\}); \\
&S \in MS;
\end{aligned} \tag{2}$$

where $M_X[F(R_s, P_i)]$ is the total integral resources for implementation of appropriate strategy in terms of external and internal environment factors; $M_X[(\bar{I}_{iT} - I_{iT})]$ is deviations of general integral index of competitiveness from the optimal criterion values.

Figure 1

Complex of models of management decisions formation for ensuring the enterprises competitiveness in volatile currency environment



Source: developed by the authors on the basis of the material Sergienko O., & Tatar M. (2011).

Module 1. Complex of models of enterprises competitiveness diagnosis considering environmental factors, which includes the construction of five interrelated models. Models of information and analytical space formation for competitiveness level estimation (M.1.1) on the bases of implementation of expert methods, correlation and regression analysis, statistical and robust estimation [19], which make possible to carryout the data research in the main areas of Ukraine metallurgical enterprises competitiveness, analyze the representativeness of the selection and create a justified indicators system according to paper Martynenko, M. (2015).

This module (M.1.1) includes searching, collecting and processing of data information space according to the main areas of the enterprise and exchange rate formation factors, analysis of the sample's representativeness and the formation of indicators system on the basis of paper Luchko O.D. (2007). The purpose of this block is the formation of a representative statistical database of research.

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 so that not to be interrelated and interdependent.

Also, it was necessary to meet the general requirements put forward to information space, namely: unique features of indicators, lack of redundancy; completeness i.e. the possibility of adequate description of various processes, facts, events of the subject that is studied by using these indicators; reliability i.e. the correspondence of the selected items of semantic information to their real value; consistency i.e. lack of homonymy have been considered by Buckley P.J. (1988). In addition, the possibility of calculating the indicators by using the available information concerning the financial activities of metallurgical enterprises was taken into account developed by the official website of the National Bank of Ukraine and State Statistics Committee of Ukraine.

Models of spatial and dynamic comparative estimation of enterprises competitiveness level (M.1.2) include the calculation of the local components of enterprise competitiveness and complex total competitiveness index of metallurgical enterprises competitiveness based on integrated rating evaluation methods that are discussed in details in the articles Sergienko O. & Tatar M. (2012) Spatial and dynamic assessment and analysis of enterprises competitiveness indicators and Complex analysis of branch trends of metallurgical enterprises' competitiveness.

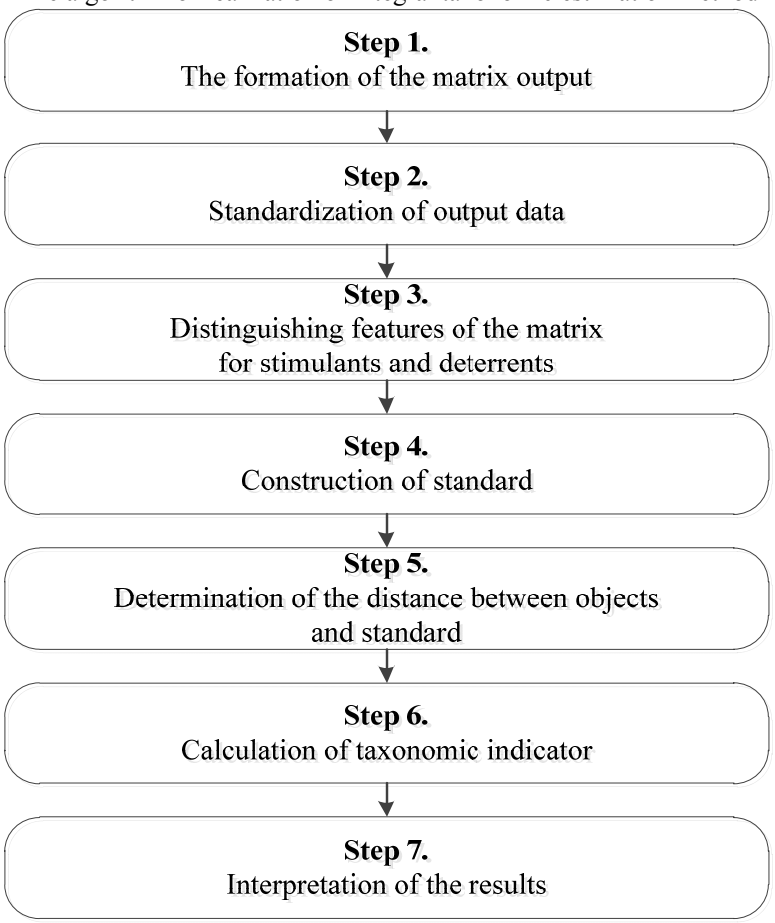
The algorithm of the integrated rating evaluation method is presented in Fig. 2. The first step is the matrix formation of output data. As the indicators of competitiveness are non-uniform, the second step involves the standardizing of their values by the formula:

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{S_j}, \tag{3}$$

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.

Figure 2

The algorithm of realization of integral taxonomic estimation method



Source: developed by the authors.

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:

$$I_i = 1 - \frac{C_{i0}}{C_0}, \tag{4}$$

where $C_0 = \overline{C_0} + 3 \times S_0$; $\overline{C_0} = \frac{1}{w}\sum_{i=1}^{w} C_{i0}$; $S_0 = \sqrt{\frac{1}{w}\sum_{i=1}^{w}\left(C_{i0} - \overline{C_0}\right)^2}$.

The system of enterprises competitiveness indicators is presented in Table 1.

Table 1

The system of enterprises competitiveness indicators

Symbol	**Indicator**	**Symbol**	**Indicator**
I_1 (products competitiveness)		I_5 (labor effectiveness)	
X_{1_1}	growth rate of prices;	X_{5_1}	turnover rate of outflow;
X_{1_2}	spoilage coefficient;	X_{5_2}	update ratio of staff;
X_{1_3}	amount of the claim;	X_{5_3}	staff turnover rate;
X_{1_4}	percentage of losses to the shaft;	X_{5_4}	proportion of university graduates;
X_{1_5}	number of quality certificates	X_{5_5}	indicator of worker's skills;
I_2 (production activity effectiveness)		X_{5_6}	loss of working hours per employee (absenteeism, simple, absence of permission);
X_{2_1}	capital productivity;	X_{5_7}	investment in employees
X_{2_2}	the profitability of production;	I_6 (investment and innovation activity effectiveness)	
X_{2_3}	labor productivity;	X_{6_1}	effectiveness ratio of investment capital;
X_{2_4}	depreciation of fixed assets;	X_{6_2}	share of long-term financial investment in assets;
X_{2_5}	rate of assets	X_{6_3}	capital investments;
I_3 (financial state)		X_{6_4}	number of scientific research;
X_{3_1}	coefficient of autonomy;	X_{6_5}	income (economical effect) on the use of innovations, inventions, useful models
X_{3_2}	absolute liquidity ratio;	I_7 (position in the stock market)	
X_{3_3}	asset turnover ratio;	X_{7_1}	average market price of common shares;
X_{3_4}	inventory turnover ratio;	X_{7_2}	net income (loss) per ordinary share;
X_{3_5}	turnover ratio of receivables;	X_{7_3}	dividends per ordinary share
X_{3_6}	accounts payable turnover ratio;		
X_{3_7}	rate of financial return		
I_4 (sales effectiveness)			
X_{4_1}	return on sales;		
X_{4_2}	growth rate of the market;		
X_{4_3}	payback ratio of distribution system;		
X_{4_4}	effectiveness ratio of advertising and sales incentives;		
X_{4_5}	number of conducted advertising and fashion companies		

Source: developed by the authors.

The following local components of competitiveness for each of the 12 enterprises in dynamics for 6 years (2008 – 2013) are calculated. Many metallurgical enterprises of Ukraine from 2008 to 2013 worked most consistently over the past few decades, which ensure the continuity of the initial data. But since 2014 with the beginning of disintegration processes and military conflict in the East of Ukraine, where the majority of metallurgical enterprises are located, the situation has changed significantly. There are problems with the availability of real data of metallurgical enterprises which are located in the East of Ukraine which leads to the fact that competitiveness assessment of some enterprises has become difficult. The integrated model of indexes for enterprise competitiveness level estimation is:

$$I_{it} = \begin{cases} I_{1\_it} = (X_{1\_1}, X_{1\_2}, X_{1\_3}, X_{1\_4}, X_{1\_5}) - products\_competitiveness; \\ I_{2\_it} = (X_{2\_1}, X_{2\_2}, X_{2\_3}, X_{2\_4}, X_{2\_5}) - production\_activity\_effectiveness; \\ I_{3\_it} = (X_{3\_1}, X_{3\_2}, X_{3\_3}, X_{3\_4}, X_{3\_5}, X_{3\_6}, X_{3\_7}) - financial\_state; \\ I_{4\_it} = (X_{4\_1}, X_{4\_2}, X_{4\_3}, X_{4\_4}, X_{4\_5}) - sales\_effectiveness; \\ I_{5\_it} = (X_{5\_1}, X_{5\_2}, X_{5\_3}, X_{5\_4}, X_{5\_5}, X_{5\_6}, X_{5\_7}) - labour\_effectiveness; \\ I_{6\_it} = (X_{6\_1}, X_{6\_2}, X_{6\_3}, X_{6\_4}, X_{6\_5}) - investment\_and\_innovation\_activity\_effectiveness; \\ I_{7\_it} = (X_{7\_1}, X_{7\_2}, X_{7\_3}) - position\_in\_the\_stock\_market \end{cases} \quad (5)$$

where X_{i_j} is the first level indicators of evaluation system of enterprise competitiveness local components; $I_{1\_it} - I_{7\_it}$ is local components of competitiveness for *i*-th enterprise ($i = 1 \div 12$) at the appropriate period of time *t* ($t = 1 \div 6$); I_{it} is the complex general indicator of the competitiveness for *i*-th enterprise ($i = 1 \div 12$) at the appropriate period of time *t* ($t = 1 \div 6$).

The calculation results of complex general indicator of Ukraine metallurgical enterprises competitiveness are presented in Table 2 and are based on the results of work Sergienko O. & Tatar M. Tools of research of evaluation and analysis of the enterprises competitive position (2011), Spatial and dynamic assessment and analysis of enterprises competitiveness indicators (2012). In order to avoid impact on the image of the analyzed enterprises they were impersonal.

The obtained values of local indicators and complex general indicator of the enterprises competitiveness for integrated assessment methodologies vary from 0 to 1, and the closer is the competitiveness values to 1, the higher is the level of enterprise competitiveness.

The analysis of complex general indicator of the enterprise competitiveness by using hierarchical and agglomerative methods of cluster analysis made possible to identify clusters of enterprises with high, average and low levels of competitiveness and to determine the enterprises, which are representants of each cluster and give the most meaningful information about cluster on the basis of the center of gravity. The distribution of metallurgical enterprises by clusters and representants of each cluster are presented in Table 3 and are based on the results of articles Sergienko O. & Tatar M. Tools of research

of evaluation and analysis of the enterprises competitive position (2011), Spatial and dynamic assessment and analysis of enterprises competitiveness indicators (2012).

Table 2

Complex general indicator of the Ukraine metallurgical enterprises competitiveness

Enterprise	Year					
	2008	2009	2010	2011	2012	2013
Ent_1	0,5707	0,6707	0,7753	0,4591	0,5583	0,5748
Ent_2	0,6569	0,6770	0,7932	0,6056	0,7793	0,7066
Ent_3	0,6237	0,5699	0,6938	0,5433	0,6053	0,6416
Ent_4	0,5580	0,6172	0,6550	0,4005	0,4671	0,4840
Ent_5	0,4463	0,5119	0,6076	0,4471	0,4776	0,3691
Ent_6	0,4370	0,5443	0,6241	0,3292	0,4503	0,5088
Ent_7	0,3006	0,2777	0,4190	0,1956	0,3564	0,3027
Ent_8	0,5903	0,5346	0,5435	0,3847	0,5294	0,5214
Ent_9	0,4836	0,4790	0,5289	0,3987	0,4533	0,4873
Ent_10	0,0701	0,0574	0,0420	0,1219	0,0776	0,1029
Ent_11	0,7044	0,6358	0,7649	0,5674	0,6006	0,6753
Ent_12	0,5597	0,5657	0,5854	0,4450	0,4294	0,4476

Source: developed by the authors.

Table 3

Distribution of metallurgical enterprises by clusters

Enter-prise	Year						M (H)	M (A)	M (L)	Cluster
	2008	2009	2010	2011	2012	2013				
Ent_1	H	H	H	A	A	H	0,66	0,33	0	H
Ent_2	H	H	H	H	H	H	1	0	0	H
Ent_3	**H**	**H**	**H**	**A**	**A**	**H**	**0,66**	**0,33**	**0**	**H (representant)**
Ent_4	**A**	**A**	**A**	**L**	**L**	**A**	**0**	**0,66**	**0,33**	**A (representant)**
Ent_5	A	A	A	L	A	A	0	0,83	0,16	A
Ent_6	A	A	A	L	L	A	0	0,66	0,33	A
Ent_7	L	L	L	L	L	L	0	0	1	L
Ent_8	A	A	A	L	A	A	0	0,83	0,16	A
Ent_9	A	A	A	L	A	A	0	0,83	0,16	A
Ent_10	**L**	**L**	**L**	**L**	**L**	**L**	**0**	**0**	**1**	**L (representant)**
Ent_11	H	H	H	A	A	H	0,66	0,33	0	H
Ent_12	A	A	A	L	L	A	0	0,66	0,33	A

Note: H - enterprises with a high level of competitiveness; A - enterprises with an average level of competitiveness; L - enterprises with low competitiveness; M (H, A, L) - probability of falling into the cluster.
Source: developed by the authors.

The distribution of metallurgical enterprises by clusters makes possible to form the general strategies of the industry development and enterprises competitiveness increase of each cluster and identify the reasons why companies move from one cluster to another. In addition, the distribution of metallurgical enterprises by clusters makes possible to

implement the series of management solutions for the respective characteristics of cluster adapted to a particular enterprise.

Models of the industry competitive environment analysis (M.1.3). Within the analysis of the competitive environment of the metallurgical industry was determined the degree of influence of local components of competitiveness on the complex general indicator of the enterprises competitiveness on the basis of panel data models building which allow us to combine both spatial data type and time series data. Taking into account that complex general indicator of the enterprises competitiveness cannot be negative, and that the values of competitiveness vary in the range [0; 1] and at maximum values of local components of competitiveness I_{k_it} cannot go beyond the specified range, the simple model of panel data without free member is constructed and rationing of this model is made. This model is:

$$I'_{it} = a_1 \times I'_{1\_it} + a_2 \times I'_{2\_it} + a_3 \times I'_{3\_it} + a_4 \times I'_{4\_it} + a_5 \times I'_{5\_it} + a_6 \times I'_{6\_it} + a_7 \times I'_{7\_it}, \quad (6)$$

where $I'_{it} = \frac{I_{it} - \overline{I_{it}}}{\sigma_{I_{it}}}$, $I'_{kit} = \frac{I_{kit} - \overline{I_{kit}}}{\sigma_{I_{kit}}}$, I'_{k_it} is standardized meaning of local components of competitiveness for k-th component of competitiveness ($k = 1 \div 7$) for i-th enterprise ($i = 1 \div 12$) in the appropriate time period t ($t = 1 \div 6$); a_k – ($k = 1 \div 7$) factor (model parameters) for the corresponding local component of enterprise competitiveness; $\overline{I_{k\_it}}$ та $\overline{I_{it}}$, are average values for the relevant local component of competitiveness and complex general indicator; $\sigma_{I_{it}}$ та $\sigma_{I_{k\_it}}$ is corresponding standard deviation.

Therefore, as a result of the following calculation we have received such model as:

$$I'_{it} = 0{,}15 \times I'_{1it} + 0{,}25 \times I'_{2it} + 0{,}26 \times I'_{3it} + 0{,}14 \times I'_{4it} + 0{,}27 \times I'_{5it} + 0{,}19 \times I'_{6it} + 0{,}30 \times I'_{7it}. \quad (7)$$

To analyze the sectoral features of the enterprises' competitiveness we propose to analyze the elasticity of indicators competitiveness for each company and the industry overall. 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 overall is presented in Table 4.

Table 4

Elasticity of competitiveness indicators for industry

Local indicators	Year						Mean
	2008	2009	2010	2011	2012	2013	
I_1 (products competitiveness)	0,12	0,10	0,08	0,15	0,09	0,10	0,11
I_2 (production activity effectiveness)	0,19	0,16	0,12	0,14	0,11	0,10	0,14
I_3 (financial state)	0,24	0,21	0,18	0,20	0,24	0,25	0,22
I_4 (sales effectiveness)	0,11	0,09	0,07	0,08	0,13	0,07	0,09
I_5 (labor effectiveness)	0,19	0,22	0,19	0,23	0,24	0,29	0,23
I_6 (investment and innovation activity effectiveness)	0,17	0,19	0,16	0,24	0,16	0,16	0,18
I_7 (position in the stock market)	0,38	0,39	0,34	0,42	0,39	0,40	0,38

Source: developed by the authors.

An average increase of production activity effectiveness for the analyzed years by 1% leads to an increase in complex general indicator of competitiveness by 0,14%. The rate increase of financial state by 1% will lead to the increase of complex general indicator by 0,22%, the improvement of labor effectiveness by 1% leads to an increase in complex general indicator by 0,23%, etc.

In terms of statistical significance and adequacy of the model, we can conclude that position in the stock market; labor effectiveness and financial state have the greatest impact on metallurgical enterprises competitiveness. The analysis of elasticity of local components competitiveness for each company and industry as a whole is made. This analysis makes possible to determine the sensitivity of the complex general indicator of competitiveness to the changes in local components of metallurgical enterprises competitiveness.

Models of estimation of the exchange rates influence on the enterprises competitiveness (M.1.4) are developed and presented in Sergienko O. & Tatar M. (2013) Models of Assessing the Effectiveness of Competitive Strategies in the Impact of Exchange Rates and Predicting Models of Exchange Rates in the System of Competitive Enterprises. In order to determine the nature and density of the relationship between the US dollar (*USD*), euro (*EUR*) and complex general indicator of the enterprises competitiveness and relevant local components of competitiveness correlation coefficients are calculated (for example, $r_{USD\_I_2}$ is the correlation coefficient between the US dollar and production activity effectiveness). Correlation coefficients between exchange rates and enterprises competitiveness indexes are presented in Table 5.

Table 5 shows that for most metallurgical enterprises there is a direct link between the US dollar and the financial state of enterprises and inverse relationship between the US dollar and production activity effectiveness. The Euro has the biggest impact on production activity effectiveness (Kavun, S., Čaleta, D., Vršec, M., & Brumnik, R., 2013) as well as investment and innovation activity effectiveness of the majority of metallurgical enterprises.

Table 5

Correlation between exchange rates and enterprises competitiveness indexes

Enterprises	Currency	
	USD	EUR
Ent_1	$r_{USDI_2} = -0,83 \quad r_{USDI_6} = -0,98$	$r_{EURI_2} = -0,86$ $r_{EURI_6} = -0,99$
Ent_2	$r_{USDI_2} = -0,86$	$r_{EURI_2} = -0,91$
Ent_3	$r_{USDI_3} = 0,88$	$r_{EURI_2} = -0,86$
Ent_4	$r_{USDI_6} = -0,91$	$r_{EURI_6} = -0,87$
Ent_5	$r_{USDI_1} = -0,91 \quad r_{USDI_6} = -0,84$ $r_{USDI_7} = -0,88$	$r_{EURI_1} = -0,84$ $r_{EURI_7} = -0,87$
Ent_6	$r_{USDI_6} = -0,88$	$r_{EURI_6} = -0,82$
Ent_7	$r_{USDI_3} = 0,82$	-
Ent_8	$r_{USDI_5} = 0,85 \quad r_{USDI_6} = -0,88$	$r_{EURI_5} = 0,88$ $r_{EURI_6} = -0,86$
Ent_9	$r_{USDI_3} = 0,87$	-
Ent_10	-	-
Ent_11	-	$r_{EURI_2} = -0,82$
Ent_12	$r_{USDI_2} = -0,83$	$r_{EURI_2} = -0,82$ $r_{EURI} = -0,83$

Source: developed by the authors.

The models of causality between the local components of the enterprises competitiveness on the one hand and between exchange rates and metallurgical enterprises competitiveness based on Granger Test on the other hand are described in the works Sergienko O. & Tatar M. Spatial and dynamic assessment and analysis of enterprises competitiveness indicators (2012) and Tools of research of evaluation and analysis of the enterprises competitive position are built for assessment of the exchange rates impact. For example, for *Ent_1* results showed that the US dollar and Euro first of all impact the products competitiveness and financial state, which in its turn affects the investment and innovation activity effectiveness. The degree of the exchange rates impact on the metallurgical enterprises competitiveness is evaluated based on panel data models.

The elasticity of enterprises competitiveness depending on exchange rates is analyzed in order to quantify the impact of exchange rates changes on the enterprises competitiveness. The results showed that if US dollar increases by 1% the products competitiveness

decreases by 1,01%; production activity effectiveness increases by 1,81%; financial state increases by 2,88%, investment and innovation activity effectiveness decreases by 1,4%, because hryvnia devaluation leads to the fact that Ukrainian companies are less attractive to foreign investors and so on. In general, US dollar increase by 1% leads to general competitiveness level increase by 0,88%, Euro increasing leads to general competitiveness level decreasing by 0,80%.

The complex of models, which is built in this paper, is the basis for development of management decisions. The results, which are obtained in this module are necessary for the implementation of Module 3.

Models of alternatives formation of enterprise competitiveness (M.1.5). The quantitative assessment of exchange rates impact on the metallurgical enterprises competitiveness makes possible to ensure the validity and quality of management decisions for improving the metallurgical enterprises competitiveness in terms of action of external and internal environment factors, with consideration for the totality of interrelated financial and economic processes.

Module 2. Complex of models for environmental factors research. The research of exchange rate factors is as very important as determination of the exchange rates impact on the metallurgical enterprises competitiveness because the factors in their totality determine exchange rates changes while factors changes manifests themselves before the exchange rates changes. Therefore, the implementation of five interrelated models is proposed for a complex research of environment factors.

Models of analysis of the environment dynamics (exchange rates) (M.2.1) include the fractal nature of market determination based on Herst Statistics and models are developed in article Predicting Models of Exchange Rates in the System of Competitive Enterprises by Sergienko O., Tatar M. (2013). By means of this Herst Index one can get an idea on preconditions of exchange rates future behavior. The results of calculations and fractal dimension for exchange rates are made in *Fractan* and presented in Table 6.

Table 6

Results of R/S analysis

Indexes	Currency	
	for USD	For EUR
Herst Index	1,5361 ± 0,3475	1,2060 ± 0,1414
Fractal dimension	0,4639 ± 0,3475	0,7940 ± 0,1414
Correlation dimension	3,205	3,331
Phase space dimension	4	6
Correlation entropy	0,004	0,077
Phase space dimension	1	>=7

Source: developed by the authors.

Herst's fluctuations in the range of $0 < H < 0,5$ means that series of values is anti-persistent and the closer is the indicator to 0, the more volatile is series and the more recession-ups it has. When $H = 0,5$ the series is a random motion (Brownian random motion). If Herst

Index is $0,5 < H < 1$ the number is persistent or trend steady, i.e. if the number increases (decreases) in the previous period, it will maintain this trend for some time in the future.

If $H > 1$, as in our case, it means that there is a steady trend, the process with fractal time and temporary break point of derivative. It shows that we have independent amplitude jumps, which are distributed by Levi during the time specified by jump size and grow with it (Hurst Statistics).

The conducted analysis of the daily behavior of exchange rates for 12 years confirmed the hypothesis of nonlinearity and fractal nature of currency market. In general, there are rather distinct trends in high volatility of exchange rates that makes it difficult to predict them and leads to currency risk increase.

Models of formation of information and analytical space for environment factors estimation (M.2.2). The information and analytical space is discussed in research by Brumnik, R., Klebanova, T., Guryanova, L., Sergienko, O., Kavun, S., & Nepomnyaschiy, V. (2014) and calculated on the basis of site data of the National Bank of Ukraine and State Statistics Committee of Ukraine for exchange rates factors is formed where exchange rates factors are combined into three groups: creating, regulatory and warning (Table 7).

Table 7

System of exchange rate factors in Ukraine

Symbol	**Factors**	**Symbol**	**Factors**
1. Creating		Fiscal	
Macroeconomic		X_{4_1}	Taxes
X_{1_1}	GDP, million UAH	X_{4_2}	Impost
X_{1_2}	Exports of goods and services, million USD	X_{4_3}	Licensing (export), number of documents
X_{1_3}	Imports of goods and services, million USD	X_{4_4}	Licensing (import), number of documents
X_{1_4}	Current transfers, million USD	Stock	
X_{1_5}	Foreign investment in Ukraine, million USD	X_{5_1}	Number exchanges, all registered
X_{1_6}	Foreign investments from Ukraine, million USD	X_{5_2}	Structure of concluded transactions on the exchanges, million UAH
X_{1_7}	Foreign exchange reserves (reserve assets), million USD	X_{5_3}	PFTS Index
Market		X_{5_4}	Total trading volume of PFTS Stock Exchange, million UAH
X_{2_1}	Volume of foreign currency purchase million UAH	X_{5_5}	Exchange turnover of USE, million UAH
X_{2_2}	Interest rates of banks in national currency on credits, %	X_{5_6}	Number of transactions concluded on the USE and its affiliates
X_{2_3}	Interest rates of banks in national currency on deposits, %	3. Warning	
X_{2_4}	Industrial production index, %	Provocative	
X_{2_5}	Volume of industrial products (works, services), million UAH	X_{6_1}	Inflation
X_{2_6}	Share of enterprises that	X_{6_2}	Producer price index of industrial

	implemented innovations, %		products, %
X_{2_7}	Rate of growth / decline of real wages, % to previous year	X_{6_3}	Reduction of foreign investments (% of GDP)
2. Regulatory		X_{6_4}	Cash in circulation outside deposit-taking corporations (M0), million UAH
Banking		X_{6_5}	Expectations of inflation
X_{3_1}	Money supply (M2)	X_{6_6}	Understanding between economic and political structures
X_{3_2}	Discount rate, %	X_{6_7}	Public confidence in the governing structures
X_{3_3}	Weighted average interest rate on all instruments, %	X_{6_8}	Presence / absence of a clearly defined program of economic recovery
X_{3_4}	Return on assets (ratio of net income to average total assets), %	Destructive	
X_{3_5}	Return on equity (ratio of net income to average capital), %	X_{7_1}	External debt, million USD
X_{3_6}	Value large exposures to capital, %	X_{7_2}	Unemployment rate, % of the economically active population
X_{3_7}	Ratio of liquid assets to total assets, %	X_{7_3}	Deficit / surplus of consolidated budget, million UAH
X_{3_8}	Value of non-performing loans to total gross loans, %	X_{7_4}	Degree of depreciation, %
		X_{7_5}	Instability of management structures
		X_{7_6}	Security / insecurity of private capital

Source: developed by the authors.

Therefore, the model of information space of exchange rates factors is:

$$\begin{cases} F_1 = f(X_{1\_1}, X_{1\_2}, X_{1\_3}, X_{1\_4}, X_{1\_5}, X_{1\_6}, X_{1\_7}) - macroeconomic; \\ F_2 = f(X_{2\_1}, X_{2\_2}, X_{2\_3}, X_{2\_4}, X_{2\_5}, X_{2\_6}, X_{2\_7}) - market; \\ F_3 = f(X_{3\_1}, X_{3\_2}, X_{3\_3}, X_{3\_4}, X_{3\_5}, X_{3\_6}, X_{3\_7}, X_{3\_8}) - banking; \\ F_4 = f(X_{4\_1}, X_{4\_2}, X_{4\_3}, X_{4\_4}) - fiscal; \\ F_5 = f(X_{5\_1}, X_{5\_2}, X_{5\_3}, X_{5\_4}, X_{5\_5}, X_{5\_6}) - stock; \\ F_6 = f(X_{6\_1}, X_{6\_2}, X_{6\_3}, X_{6\_4}, X_{6\_5}, X_{6\_6}, X_{6\_7}, X_{6\_8}) - provocative; \\ F_7 = f(X_{7\_1}, X_{7\_2}, X_{7\_3}, X_{7\_4}, X_{7\_5}, X_{7\_6}) - destructive \end{cases} \quad (8)$$

where X_i is first-rate indicators of exchange rates factors; F_i is local integral factors of the exchange rate dynamics.

The obtained statistical characteristics of indicators are the basis for classification of the exchange rate factors by cluster analysis methods in a neutral state (2001 – 2003 years),

unfavorable (2004 – 2008 years), and aggressive state (2009 – 2013 years). Models of environmental factors relationship estimation (M.2.3). The interference of exchange rates and factors of their formation based on ECM - modeling (models adjustment error) is determined. The equation co-integration (long-term) interconnection of exchange rates and factors of their formation is:

$$\begin{cases} D(USD) = -1{,}33 \times (USD_{(t-1)} - 0{,}48 \times F_{2(t-1)} + 0{,}51 \times F_5(t-1) - 1{,}40 \times F_{7(t-1)}) - 32{,}65 \\ D(EUR) = 0{,}28 \times (EUR_{(t-1)} + 1{,}49 \times F_{2(t-1)} - 4{,}96 \times F_{3(t-1)} + 10{,}83 \times \\ \times F_{4(t-1)} + 2{,}81 \times F_{7(t-1)}) - 65{,}54 \end{cases} \quad (9)$$

Taking into account the lag period of 1 the destructive exchange factors make the greatest influence on US dollar and fiscal and banking factors – on euro are based on the calculations obtained in the paper Sergienko O., Tatar M. (2013) Predicting Models of Exchange Rates in the System of Competitive Enterprises.

Models of exchange rates and factors of their formation forecasting (M.2.4). The important element of metallurgical enterprises competitiveness management is forecasting of changes in currency environment. The forecasting of exchange rates (based on adaptive models, neural networks, ARCH and GARCH-models); exchange rates factors (using VAR-analysis) and the factors status (based on discriminant analysis methods) are made in this paper. The results have shown that US dollar and euro will grow. The dynamic simultaneous equations systems for predicting the dynamics of creating, regulatory and warning factors are:

- for creating factors:

$$\begin{cases} F_1 = -1{,}30 \times F_{1(t-1)} - 0{,}89 \times F_{1(t-2)} + 0{,}08 \times F_{2(t-1)} + 0{,}29 \times F_{2(t-2)} + 0{,}11 \\ \\ F_2 = 1{,}67 \times F_{1(t-1)} + 2{,}42 \times F_{1(t-2)} - 0{,}64 \times F_{2(t-1)} - 1{,}38 \times F_{2(t-2)} - 0{,}19; \end{cases} \quad (10)$$

- for regulatory factors:

$$\begin{cases} F_3 = -0{,}89 \times F_{3(t-1)} - 0{,}64 \times F_{3(t-2)} + 1{,}11 \times F_{4(t-1)} - 1{,}90 \times F_{4(t-2)} - 1{,}89 \times F_{5(t-1)} - \\ - 1{,}51 \times F_{5(t-2)} + 0{,}14 \\ \\ F_4 = -2{,}23 \times F_{3(t-1)} - 0{,}34 \times F_{3(t-2)} + 4{,}64 \times F_{4(t-1)} - 3{,}34 \times F_{4(t-2)} - 1{,}95 \times F_{5(t-1)} - \\ - 4{,}26 \times F_{5(t-2)} + 0{,}21 \\ \\ F_5 = -1{,}34 \times F_{3(t-1)} + 0{,}10 \times F_{3(t-2)} + 2{,}65 \times F_{4(t-1)} - 3{,}21 \times F_{4(t-2)} - 1{,}88 \times F_{5(t-1)} - \\ - 2{,}93 \times F_{5(t-2)} + 0{,}24; \end{cases} \quad (11)$$

- for warning factors:

$$\begin{cases} F_6 = 0{,}27 \times F_{6(t-1)} - 0{,}39 \times F_{6(t-2)} - 0{,}52 \times F_{7(t-1)} + 0{,}20 \times F_{7(t-2)} - 0{,}04 \\ F_7 = -0{,}03 \times F_{6(t-1)} + 0{,}28 \times F_{6(t-2)} - 0{,}36 \times F_{7(t-1)} + 0{,}04 \times F_{7(t-2)} - 0{,}04; \end{cases} \quad (12)$$

The analysis of future trends in exchange rate factors with consideration for lag delay in periods 1 and 2 has shown macroeconomic factors growth with simultaneous deterioration of warning factors indicating that the economic system moves off dynamic equilibrium. Forecasting of exchange rates factors based on discriminant analysis techniques allowed us to obtain predicted state of exchange rate factors, which can be interpreted as aggressive. The models make possible to pre-form the enterprises competitive strategies under the exchange rates influence.

Models of environmental strategies formation (M.2.5) provide the implementation of matrix models, expert analysis, decision theory, that makes possible to generate pre-competitive strategies of metallurgical enterprises development and enable the company's management to respond to unfavorable exchange rate dynamics and factors of its formation. It will help increase the competitiveness and efficiency of enterprise activity overall.

Module 3. Complex of management solutions models that ensure the enterprises competitiveness in unstable currency environment provides the implementation of three models.

Models of environmental factors influence estimation on the enterprises competitiveness (M.3.1). The evaluation of the exchange rate factors impact on the enterprises competitiveness based on selected states of exchange rate factors and their numerical characteristics is made using the method of fuzzy logic. The function of membership for each exchange rate factor and the output index is built based on certain linguistic variables, which take into account state of exchange rate factors.

The ranges of environmental conditions based on the minimum and maximum values for each cluster are shown in Table 8. Their combination is the basis for administrative rules and determines the strength of their influence.

Table 8

The range of environmental conditions

Indicators	State of the environment		
	Neutral	Unfavorable	Aggressive
Macroeconomic	0,4051-0,5275	0,2652-0,4654	0,1458-0,2552
Market	0,0390-0,6436	0,3600-0,5302	0,4310-0,6313
Banking	0,3112-0,5160	0,1290-0,5141	0,1794-0,4800
Fiscal	0,2023-0,3295	0,1546-0,2091	0,1037-0,1592
Stock	0,4785-0,6754	0,3865-0,5287	0,2017-0,2748
Provocative	0,6919-0,9297	0,2904-0,5136	0,4608-0,5124
Destructive	0,5028-7427	0,5837-0,6448	0,1519-0,3296

Source: developed by the authors.

These membership functions of linguistic variables to fuzzy sets for the output variable are given in Table 9.

The results have shown that the impact of exchange rates factors predictive values on the enterprises competitiveness is equal to 0,272. It means that it belongs to the fuzzy set «acceptable level of influence» with a probability of 0,9, that is that the company under exchange rate factors will move lower in the cluster.

Table 9

Constructing membership functions of linguistic variables to fuzzy sets (detail)

№	Output variable	Linguistic variable	Membership function
1.	Macroeconomic (F_1)	Aggressive state	$\mu(x) = zmf(0.2;\ 0.509)$
		Unfavorable	$\mu(x) = gaussmf(0.14; 0.375)$
		Neutral	$\mu(x) = smf(0.251;\ 0.557)$
…	…	…	…
8.	The level of impact on the competitiveness	adjustable	$\mu(x) = zmf(0.05;\ 0.2)$
		allowable	$\mu(x) = gaussmf(0.149; 0.209)$
		critical	$\mu(x) = smf(0.26;\ 0.4)$

Source: developed by the authors.

When we predict the exchange rates, we can predict a change in the competitiveness levels in the future due to changes in exchange rates. Thus, if the US dollar increases by 1% (in short-term period) the competitiveness level will increase by 0,88%. If according to one of the possible scenarios the predicted US dollar will rise in 30 days on average 0,22%, the competitiveness level will increase by 0,19%.

Models of competitive strategies choice in unstable currency environment (M.3.2). The analysis, evaluation and forecasting of the exchange rates and factors of their formation impact on the enterprises competitiveness are carried out for determining the effective management methods of metallurgical enterprises competitiveness in unstable currency environment according to the results Sergienko O. & Tatar M. (2013), Models of Assessing the Effectiveness of Competitive Strategies in the Impact of Exchange Rates. The structural form of the proposed model of competitive strategies of metallurgical enterprises is:

$$\mathrm{SC}_{\mathrm{it}} = \{I_{it}; F_t; E_t\}, \tag{13}$$

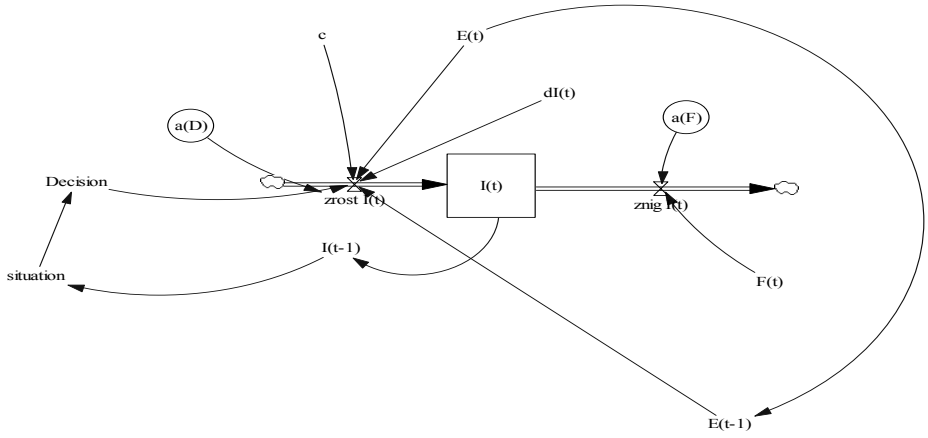
where SC_{it} is competitiveness of enterprise management strategy under the exchange rate and the factors of its formation impact; I_{it} is the complex general indicator of competitiveness of the i-th enterprise in the t-th period of time; F_t is the exchange rate factors impact on the competitiveness of enterprises in t-th time; E_t is the predicted exchange rate in the t-th period of time.

Depending on the metallurgical enterprises competitiveness level, the exchange rate and the factors of its formation impact and predicted dynamics of the exchange rate three classes of situations were formed: favorable; neutral; unfavorable. Depending on the aforementioned situations, the behavior of individuals who make decisions will be different, which explains the need to consider several management decisions alternatives: 1) the manager has not taken a decision (no response); 2) standard (typical) decisions (identified in the survey of enterprises managers); 3) innovative, creative solutions.

Models of estimation of management decisions effectiveness for enterprises competitiveness ensuring (M.3.3). Three-component dynamic simulation model is built in order to assess the effectiveness of management solutions and is based on the aggregation of research results by Sergienko O. & Tatar M. Tools of research of evaluation and analysis of the enterprises competitive position (2011) and Models of Assessing the Effectiveness of Competitive Strategies in the Impact of Exchange Rates (2013) (Fig. 3).

Figure 3

Three-dynamic simulation model of effectiveness of management decisions estimation



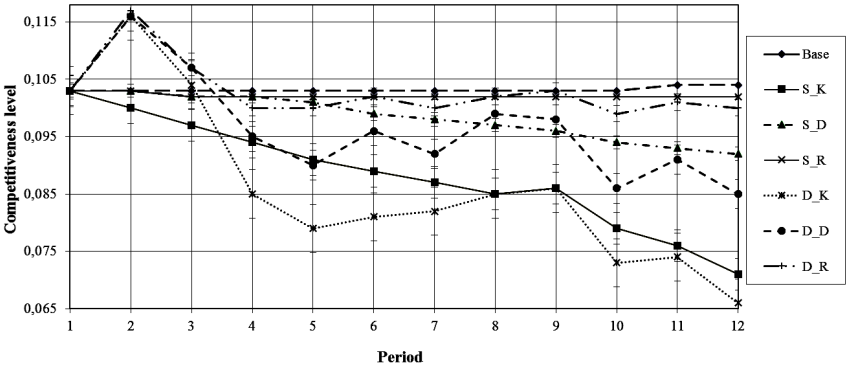
Source: developed by the authors.

Simulation experiments were conducted for enterprises-representants of each cluster. The conditions of the base experiment (*Base*) provided conditional exchange rate stability, absence of the exchange rate influence factors, absence of management decisions for improving competitiveness. Under these conditions, *Ent_3* will increase competitiveness level a bit, even in the absence of aimed specific management decisions. In the adjustable level of the exchange rate factors influence (*S_R*) the enterprise competitiveness level in an average period will be on 1,6% below the level of the basic experiment, in the allowable level (*S_D*) – on 6,7%, in critical level (*S_K*) – on 13,4 %. Thus, under these conditions, in the absence of any management influence the competitiveness of enterprise will decrease very much (Fig. 4).

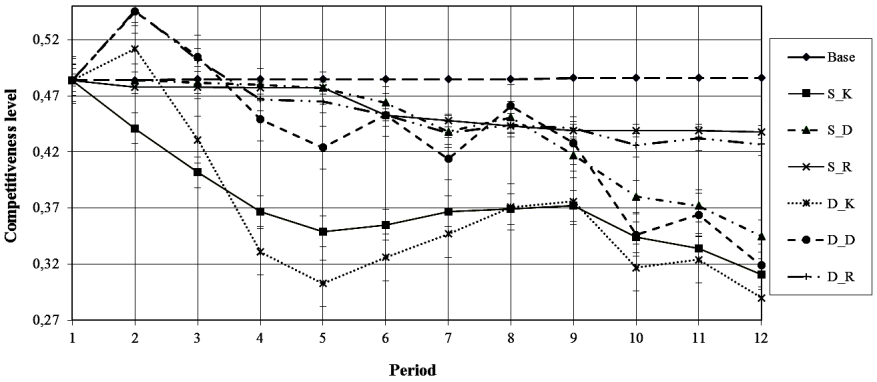
Figure 4

The results of simulation experiments of exchange rate influence factors on the enterprises competitiveness based on decisions

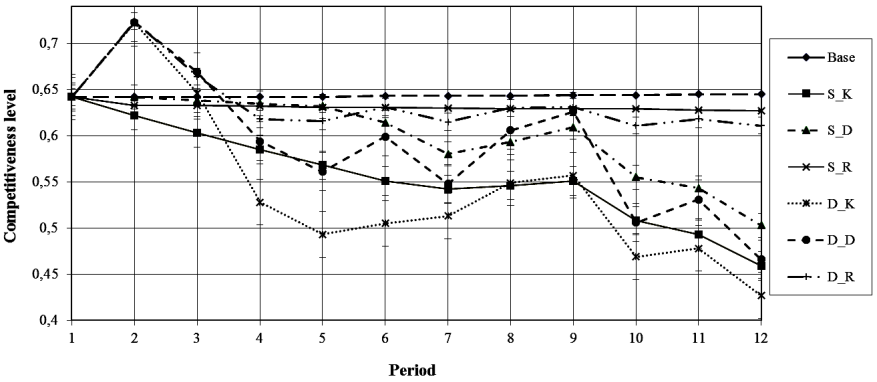
a) for *Ent_3*



b) for *Ent_4*



c) for *Ent_10*



Source: developed by the authors.

Simulation experiments that reflect results of management decisions (*D*), which are adopted by the enterprise in accordance with the class of situation are showed that the enterprise competitiveness level will increase substantially in the second and third period (months) and then will decrease.

4. Results and suggestions

Therefore, the complex of models, which was built, can improve the system of management in general by means of adequate and timely solutions to the following tasks:

- the diagnostic of metallurgical enterprises competitiveness and its industry trends of development using modern tools of economic and mathematical modeling of statics and dynamics makes possible to get enterprises with high, average and low competitiveness level and determine the impact of local components on the complex general indicator of the enterprises competitiveness;
- the assessment of the exchange rates impact on the metallurgical enterprises competitiveness on the basis of panel data models makes possible to reveal the local components of the enterprises competitiveness where the exchange rates affect is the greatest;
- the forecasting of exchange rates, factors of exchange rates and their state which allowed us to identify future changes in the currency environment and to direct management on the development of enterprises capacity for adaptation to the sharp fluctuations in exchange rates, which will increase the metallurgical enterprises competitiveness;
- the assessment of exchange rate factors impact on the metallurgical enterprises competitiveness using fuzzy logic methods led to the conclusion about the need to introduce measures to minimize the unfavorable currency environment impact on the metallurgical enterprises competitiveness.

5. Conclusion

Thus, implementation of complex of management models of metallurgical enterprises competitiveness in unstable currency environment based on the evaluation of the metallurgical enterprises competitiveness level and industry trends of development will ensure the validity and quality of management solutions for improving the metallurgical enterprises competitiveness. There is possible in terms of factors of external and internal environment with consideration for the totality of interrelated financial and economic processes. The proposed complex of management models of metallurgical enterprises competitiveness in unstable currency environment can be applied in modified version in other countries taking into account the specifics of these countries, their level of development, and level of competition in the metallurgical industry in these countries, etc.

References

Ambastha, A., Momaya, K. (2004). Competitiveness of Firms: Review of theory, framework and models. – Singapore Management Review, 26(1), p. 45-61.

Azoev, G. L. (1996). Competition: analysis, strategy, practice. M.: Center for Economics and Marketing, 172 p.

Belenky, P. (2007). Investigating the problems of competitiveness. – National Library of Ukraine, 5, p. 9-18.

Belinska, Y. V. (2009). Problems of exchange rate stability in Ukraine. – Actual Problems of Economy, 8 (98), p. 200-207.

Bereslavska, O. I., Serebryansky, D. M. (2009). Exchange rate policy and its impact on economic competitiveness of Ukraine. – Actual Problems of Economy, 8(98), p. 209-214.

Brumnik, R., Klebanova, T., Guryanova, L., Sergienko, O., Kavun, S., Nepomnyaschiy, V. (2014). Synthesis of Systems Modeling for Early Crisis Forecasting and Prevention. – European Journal of Scientific Research, 118(1), p. 7-22.

Buckley, P. J. (1988). Measures of International Competitiveness a Critical Survey. – Journal of Marketing Management, 4(2), p. 175-200.

Danich, V. (2004). Investigation of the dynamics of fast economic and social processes (on the example of currency panics). – Vestnik VNU, Lugansk: Izd. VNU, 4 (74), p. 198-207.

Depperu, D., Cerrato, D. (2005). Analyzing International Competitiveness at the Firm Level: Concepts and Measures. – Working Paper, 32: Dipartimento Scienze Sociali-Sezione Economia Aziendale, Universita Cattolica del Sacro Cuore, Piacenza.

Fathutdinov, R. A. (2000). Competitiveness: economy, strategy, management. INFRA-M, 351 p.

Goncharova, T. S. (2008). Study of factors, which influence the exchange rate. – Visn. Don. nat. university of economy and trade named by Tugan-Baranovsky, 6, p. 46-50.

Hurst Statistics. Available at: http://www.liveinternet.ru/community/ 2202959/post62177758/.

Ivanov, Y. B, Tishchenko, O. N., Drobitko, N. A., Golovko, O. S. (2003). Competitiveness of the enterprise: assessment, diagnosis, strategy. Monograph, Kh.: KhGEU, 349 p.

Kavun, S., Čaleta, D., Vršec, M., Brumnik, R. (2013). Estimation of the Effectiveness and Functioning of Enterprises in Boards of Corporate Security. – European Journal of Scientific Research, 104(2), p. 304-323.

Luchko, O. D. (2007). The analysis of the competitiveness of enterprises. – Investment: practice and experience, 23, p. 33-37.

Martynenko, M. (2015), Formation of organisational knowledge in Ukrainian enterprises on the basis of internal communications. – Economics and Sociology, Vol. 8, N 1, p. 88-105.

Parshina, O. A. (2008). Competitiveness management of engineering products. Monograph, Dnipropetrovsk: National Mining University.

Porter, M. (2008). Competition. USA: Harvard Business School Publishing Cooperation.

Sergienko, O., Tatar, M. (2012). Spatial and dynamic assessment and analysis of enterprises competitiveness indicators. – Business Inform, 4, p. 41-46. Available at: http://www.business-inform.net/annotated-catalogue/?year=2012& abstract=2012 04_0 &lang=ru&stqa=10.

Sergienko, O., Tatar, M. (2011). Tools of research of evaluation and analysis of the enterprises competitive position. – Problems of Economics, 3, p. 90-94. Available from: http://www.problecon.com/pdf/2011/3_0/90_94.pdf.

Sergienko, O., Tatar, M. (2012). Complex analysis of branch trends of metallurgical enterprises' competitiveness. – Journal of Transport Economics and Industry. Coll. of scientific works of Ukrainian State Academy of Railway Transport, 38, p. 214-222.

Sergienko, O., Tatar, M. (2013). Models of Assessing the Effectiveness of Competitive Strategies in the Impact of Exchange Rates. – Economy Development, 4(68), p. 37-43. Available at: http://www.ed.ksue.edu.ua/ER/knt/ee134_68/ e134se2.pdf.

Sergienko, O., Tatar, M. (2013). Predicting Models of Exchange Rates in the System of Competitive Enterprises. – Problems of Economics, 2, p. 268-278. Available at http://www.problecon.com /pdf/2013/2_0/268_278.pdf.

The official website of the National Bank of Ukraine. Available at: http://bank.gov.ua.

The official website of the State Statistics Committee of Ukraine. Available at: http://ukrstat.gov.ua.

Trydid, O. (2002). Comprehensive assessment of the enterprise competitive status. – Economy Development, 2(22), p. 75-76.

Voronkova, A. E. (2009). Competitiveness of enterprises: management mechanism and diagnostics. – Economy of Industry, 3, p. 133-137.

Wint, A. (2003). Competitiveness in small developing economies: insights from the Caribbean. Canada: University of the West Indies Press. Available at: http://www.questia.com/PM.qst?a= o&d=104310446.

Zadoya, A. A. (2009). The exchange rate and its impact on the motivation of the foreign economic activity. – Acad. Review of Economics and Business, 1, p. 137-150.

Zhuravka, F.O. (2006). Exchange rate policy of the National Bank of Ukraine as a factor of influence on the price competitiveness of Ukrainian enterprises. – Problems and prospects of the banking system of Ukraine: collection of papers, 18, p. 73-81.