ПРОБЛЕМИ НАЦІОНАЛЬНОЇ ТА РЕГІОНАЛЬНОЇ ЕКОНОМІКИ

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LOGISTICS SYSTEM AS A DIRECTION FOR INCREASING COMPETITIVENESS OF THE METALLURGICAL PLANTS OF UKRAINE

Market relations in Ukraine are characterized by dynamism of the external environment, aggravation of competition between producers, increase of the level of commercial risk; require the enterprises of the mining and metallurgical industry of Ukraine to find effective ways of ensuring competitiveness, strengthening the competitive position and competitive status. Timely and uninterrupted supply of metallurgical complexes with quality secondary raw materials, sufficient for stable production volume, is an extremely important task that determines the economic security and competitiveness of ferrous metallurgy. Enterprise competitiveness management involves the introduction of modern logistics systems, taking into account the specifics of the competitive environment of the market and is a necessary and important strategic direction for improving the competitiveness of the enterprise. Today, in the secondary steel market, Ukraine's decision-making in the competitive behavior model is, in most cases, intuitive, without a fundamental basis and careful strategic analysis. Only a balanced approach to the assessment and use of competitive factors ensures business development and its advantages over competing companies. The implementation of this approach is an important task of management and marketing of the enterprise. In many ways, the solution to the problem of competitiveness of domestic metallurgical enterprises will depend on the possibility of its analysis. The methods of estimation of concentration level and monopolization of ferrous scrap market of Ukraine, which is a strategic raw material for metallurgical plants, are considered in the article. Approaches and indicators are analyzed to analyze the degree of market concentration: the coefficient of market concentration; Herfindahl-Hirschman coefficient; Rosenbluth coefficient (Hall-Tidman) is an indicator of market share entropy; Gini index. The share of metallurgical plants of Ukraine specializing in scrap metal processing and processing is analyzed and established. The current state and level of competition in the secondary steel market of Ukraine have been determined. On the basis of certain indicators, metallurgical plants of Ukraine have the opportunity to create an effective system for managing the competitiveness of enterprises, which are a prerequisite for achieving their strong competitive positions.

Keywords: *market concentration; scrap market; steel; concentration indicators; level of concentration; logistics systems.*

JEL Classification: *L61, O52*

ЛОГІСТИЧНА СИСТЕМА ЯК НАПРЯМ ПІДВИЩЕННЯ КОНКУРЕНТОСПРОМОЖНОСТІ МЕТАЛУРГІЙНИХ КОМБІНАТІВ УКРАЇНИ

Ринкові відносини в Україні характеризуються динамічністю зовнішнього середовища, загостренням конкурентної боротьби між виробниками, підвищенням рівня комерційного ризику, що вимагають від підприємств гірничо-металургійної галузі України пошуку ефективних шляхів забезпечення конкурентоспроможності, зміцнення конкурентної позиції та конкурентного статусу. Своєчасне і безперебійне забезпечення металургійних комплексів якісною вторинною сировиною, в достатній для стабільного виробництва обсязі, є надзвичайно важливим завданням, що визначає економічну безпеку і конкурентоспроможність чорної металургії. Управління конкурентоспроможністю підприємства передбачає впровадження сучасних логістичних систем з врахуванням специфічності конкурентного середовища ринку та є необхідним і найважливішим стратегічним напрямом підвищення конкурентоспроможності підприємства. Сьогодні на ринку вторинної сталі України прийняття тих чи інших управлінських рішень щодо моделі конкурентної поведінки відбувається в більшості випадків інтуїтивно, без фундаментального підґрунтя та ретельного стратегічного аналізу. Тільки збалансований підхід до оцінки та використання факторів конкурентоспроможності забезпечує розвиток бізнесу та його переваги у порівнянні з компаніями-конкурентами. Реалізація цього підходу є важливим завданням менеджменту та маркетингу підприємства. Багато в чому вирішення проблеми конкурентоспроможності вітчизняних металургійних підприємств буде залежати від можливості її якісного аналізу. У статті розглянуто методи оцінки рівня концентрації та монополізації ринку брухту чорних металів України, який є стратегічною сировиною для металургійних комбінатів. Досліджені підходи та показники, що дозволяють проаналізувати ступінь концентрації ринку: коефіцієнт ринкової концентрації; коефіцієнт Герфіндаля-Гіршмана; коефіцієнт Розенблюта (Холла-Тайдмана); показник ентропії ринкових часток; індекс Джинні. Проаналізовано та встановлено частку металургійних комбінатів України, які спеціалізуються на заготівлі та переробці металобрухту. Визначено сучасний стан і рівень конкурентної боротьби на ринку вторинної сталі України. На базі визначених показників металургійні комбінати України мають можливість створення ефективної системи управління конкурентоспроможністю підприємств, що є передумовою досягнення ними міцних конкурентних позицій.

Ключові слова: *концентрація ринку; ринок металобрухту; чорна металургія; показники концентрації; рівень конкуренції; логістичні системи.*

Relevance of the problem. The mining and metallurgical sector is a key part of the Ukrainian industry. It is closely related to other sectors of the Ukrainian economy and is a leading sector of the national economy of Ukraine: production volumes make more than 20% of Ukraine's GDP.

However secondary steel (sometimes called 'scrap steel') is a strategically important raw material for the Ukrainian mining and metallurgical sector, there is no regulated and transparent market for secondary ferrous metals in Ukraine. Businesses do not consider scrap steel as a product that has different quality categories and, therefore, there are no differentiated prices on it [7].

It is well-known that the main criterion of stability of an enterprise is its competitiveness. Hence, the process of analysis, assessment and forecasting is necessary in order to maintain and improve metallurgy enterprises position on the market. Moreover, in the conditions of fierce competition, the special attention must be given to the development of modern approaches to planning, management and control of assets, information and financial flows, so that an enterprise can increase its competitiveness. An effective logistic of metallurgical plants, that purchase and process ferrous scrap, contributes to their competitive advantages: in particular, it reduces a prime cost of finished products due to cost minimization.

The unstable environment and poor abilities to adapt to any of market transformations create dangerous conditions for enterprises competitiveness and require from top managers to design new approaches to a manufacturing and an economic activity, and new methods and principles of organization management [5].

Due to the fact that the majority of data on the domestic secondary steel market is not published in order to ensure the compliance with the requirements of the Law of Ukraine "On State Statistics" (the law on the confidentiality of statistical information), there is a lack of information on the functioning of metallurgical market – there is a difficulty in conducting a comprehensive diagnostics of the competitive environment of the secondary steel market.

Previous research analysis. The theoretical aspect of the problem of formation and management of enterprise competitiveness was investigated by many foreign and domestic scientists: D. Ricardo, I. Ansoff, V. Apopi, G. Armstrong, P. Drucker, F. Kotler, M. Porter, E. Hecksher, A. Voronkova, V. Gerasimchuk, D. Dykan, N. Efremova, O. Kuzmin, L. Ligonenko, M. Losev, T. and Y. Litvinenko, I. Loshenyuk, A. Mazaraki, N. Malyar, B. Olin, J. Petrovich, E. Revtyuk, S. Skibinsky, I. Smolin, S. Sobol, N. Tarnavska, N. Ushakova, F. Khmil, V. Shvets, and others. However, a comprehensive and systematic analysis of the current condition of the scrap steel market was not conducted.

One of the most vital problems of modern world and domestic metallurgy is the issue of providing steelmaking with the necessary raw materials. Each industrialized country seeks to maximize the use of secondary raw materials in the metallurgical industry, solving in this way not only the problem of harmful emissions into the environment, but also problems of depletion of iron ore reserves and increasing of prices for finished metallurgical products [4].

Therefore, the study of ways to improve the efficiency of management is becoming one of the most relevant ones for maintaining of enterprise competitiveness and long-term prospects for its development.

The purpose of the article is to analyze the situation with the competitive environment of the scrap steel market, to determine approaches and indicators that allow to assess the degree of competition on the market.

Main body. Steel production plays an important role in the modern world. Steel products are among the most important materials for each country construction industry and infrastructure [1]. Enterprises of the metallurgical sector of Ukraine, which belong to the private sector, were not ready to face all the challenges of the global crisis, namely: declines in demand for low quality metal products, the increased competition level and an emergence of new players on the world markets [8]. Scrap steel procurement and processing is a logical beginning of the metallurgical industry, as the production chain of the complex mechanism of the mining and metallurgy in Ukraine originates from the collecting, sorting and processing of ferrous scrap. The main competitive advantages of the metallurgy enterprises work with their suppliers lie in the developed procurement network in different regions of Ukraine, as well as in transportation services that aim the scrap provision. The most important factors that have the great impact on the formation of scrap prices are the conditions of supply, transportation, loading and unloading of ferrous scrap. Despite the fierce competition in the world markets, the unstable political and economic situation in the country, it is necessary for metalworking enterprises to develop and implement measures that aim at reducing the scrap purchasing and production costs. That is why a logistical approach implies a logistic service, the purpose of which is to manage assets flows at all stages of their transportation.

The general purpose of market research is to determine the conditions of the efficient organization of production and economic activity in order to meet the needs of processed raw materials consumers.

Important tasks of the competitive analysis are: to determine the volume and dynamics of market shares of competing companies, to investigate the factors and trends in the dynamics of market share of enterprises researched, to determine the type of statistical distribution of market shares, to research the formation of groups of enterprises and the calculation of the average market share for each group [2].

In order to assess the level of market monopolization, we will calculate the following indicators:

– the coefficient of market concentration;
– the Herfindahl-Hirschman coefficient;
– the Rosenbluth coefficient (Hall-Tidman);
– the entropy index of market shares;
– the Gini index [3].

For further analysis of the secondary raw material market (ferrous scrap), the proportion of each metallurgical plant that procure and process secondary steel in Ukraine was calculated in Table 1.

The most common indicator of market monopolization is the concentration ratio (CR_n), that shows the aggregate market share of the four largest enterprises.

The concentration coefficient is calculated with the formula 1:

$$CR_n = \frac{CR_1 + CR_2 + CR_3 + CR_4}{CR}, \quad (1)$$

where CR – total purchase volume of scrap steel at Ukrainian metallurgical enterprises;

CR_1, CR_2, CR_3, CR_4 – first, second, third and fourth companies on the market with the maximum volume of scrap steel purchases.

Table 1

The calculation of the market shares of metallurgical plants that procure and process secondary steel in Ukraine in 2018

Name of a metallurgical plant	Purchase volume, thousand tons	Market share, %	Market share (S_i)
PJSC AZOVSTAL IRON AND STEEL WORKS	667	21,62	0,22
JSC INTERPIPE DNEPROVTORMET	608	19,70	0,20
PJSC ARCELORMITTAL KRYVYI RIH	579	18,76	0,19
PJSC DNEPROVSKY IRON & STEEL INTEGRATED WORKS	420	13,62	0,14
LLC ELEKTROSTAL-KURAKHOVO	324	10,50	0,10
PJSC ZAPORIZHSTAL	197	6,38	0,06
PJSC ILYICH IRON AND WORKS OF MARIUPOL	115	3,74	0,04
PRJSC DNIPROSPETSSTAL	96	3,11	0,03
PJSC ENERGOMASHSPETSSTAL	41	1,33	0,01
PJSC DMP	38	1,23	0,01
Total	3 086	100,00	1,00

Source: calculated and systematized by the authors according to the source [6]

$$CR_{n2018} = \frac{667 + 608 + 579 + 420,4}{3085,8} = 0,74 \; or \; 74\% \qquad (2)$$

According to the results of the calculations, the coefficient of concentration of the secondary raw materials market in 2018 was 74%. It shows that this market is highly concentrated, characterized by a small number of interdependent metallurgical enterprises and a high level of barriers to entry. As the figure exceeds 70%, a single or collective monopolization may be observed on the secondary steel market of Ukraine.

More descriptive is the Herfindahl-Hirschman coefficient (I_n), which is calculated as the sum of squares of market shares of all metallurgical enterprises that operate on the market. The environment is considered as a competitive one if the index is less than 1000. This indicator is an important criterion for the implementation of antitrust policies in developed countries, as it determines when the process of issuing of permissions for a merger of enterprises on a specific market is allowed. If the index value exceeds 1800, then the market is considered as non-competitive and mergers are prohibited [3].

$$I_n = \Sigma S_i^2, \qquad (3)$$

where S_i is the share of the ith enterprise in the total volume of scrap metal purchases on the market (in %).

$$I_{n2018} = 18,76^2 + 19,70^2 + 21,62^2 + 10,50^2 + 13,60^2 + 6,38^2 + \\ +3,74^2 + 3,11^2 + 1,23^2 + 1,33^2 = 352,06 + 388,21 + 467,21 + \qquad (4) \\ +110,24 + 185,61 + 40,76 + 13,99 + 9,68 + 1,52 + 1,77 = 1571,1$$

Therefore, in 2018, the Herfindahl-Hirschman coefficient (I_n) for the secondary steel market is considered as moderately concentrated and oligopolistic. Mergers and acquisitions are allowed on the market, but, relying on the US legislative experience, the control from the side of regulatory authorities is required. Moreover, there is the need in obtaining a merger permit from government agencies.

According to Lupak R. L. [3]: "The Rosenbluth (Hall-Tidman) coefficient (I_n) allows to take into account the rank of an enterprise depending on the size of its market share. The maximum value of the coefficient is 1 (under monopoly conditions), the minimum value is 1/n (n is the number of enterprises in the industry)".

Therefore, the coefficient eliminates the shortcomings of the Herfindahl-Hirschman index, since it is calculated with taking into account the ordinal number of the enterprise that is obtained on the basis of the ranking of shares from maximum to minimum.

The coefficient of Rosenbluth (Hall-Tidman) (I_r) is calculated with the formula:

Table 2

The calculation of the Rosenbluth (Holla-Tidman) coefficient for the secondary steel procurement and processing market in 2018

Name of a metallurgical plant	Market share (S_i)	Ranking, i	$(i \times S_i)$
PJSC AZOVSTAL IRON AND STEEL WORKS	0,22	1/1	0,22
JSC INTERPIPE DNEPROVTORMET	0,20	1/2	0,10
PJSC ARCELORMITTAL KRYVYI RIH	0,19	1/3	0,06
PJSC DNEPROVSKY IRON & STEEL INTEGRATED WORKS	0,14	1/4	0,03
LLC ELEKTROSTAL-KURAKHOVO	0,10	1/5	0,02
PJSC ZAPORIZHSTAL	0,06	1/6	0,01
PJSC ILYICH IRON AND WORKS OF MARIUPOL	0,04	1/7	0,01
PRJSC DNIPROSPETSSTAL	0,03	1/8	0,00
PJSC ENERGOMASHSPETSSTAL	0,01	1/9	0,00
PJSC DMP	0,01	1/10	0,00
Total	1,0		0,45

Source: calculated and systematized by the authors according to the source [6]

$$I_r = \frac{1}{2\sum(i \times S_i) - 1}, \quad (5)$$

where S_i is the share of the enterprise with number i in the total volume of scrap steel purchases on the market (in %).

i – the rank of an enterprise, depending on its share in the market.

Relying on statistical analysis, the figures of the Rosenbluth (Hall-Tidman) coefficient for the market of secondary steel procurement and processing in Ukraine in 2018 was calculated (Table 2).

$$I_r 2018 = 1/2 \times \begin{pmatrix} 1/1 \times 0,2162 + 1/2 \times 0,0985 + 1/3 \times 0,0625 + 1/4 + \\ + \times 0,0341 + 1/5 \times 0,0210 + 1/6 \times 0,0106 + 1/7 \times \\ \times 0,0053 + 1/8 \times 0,0039 + 1/9 \times 0,0015 + 1/10 \times 0,0012 \end{pmatrix} - 1 = 0,91 \quad (6)$$

Therefore, the Rosenbluth (Hall-Tidman) ratio (I_r) for the secondary steel market in 2018 was 0.91, which is close to 1. In this case, there is a reason to conclude that one of the enterprises of the secondary steel market, namely PJSC AZOVSTAL IRON AND STEEL WORKS, has the opportunity to establish a monopoly.

The entropy indicator depicts the degree of market structure indeterminacy, as well as the level of uncertainty and unsystematic character of market shares distribution among market enterprises as indirect evidence of the increased competition and the reduced concentration. The higher the ratio, the greater the economic uncertainty and the lower the concentration of the market.

The entropy index is calculated with the formula:

$$E = \sum_{i=1}^{n} S_i \ln\left(\frac{1}{S_i}\right), \quad (7)$$

where S_i is the share of the enterprise with number i in the total volume of scrap steel purchases on the market (in %).

The results of entropy calculations for the Ukrainian secondary steel market in 2018 are shown in Table 3.

The entropy index of the secondary steel market in 2018 is 1.99, which indicates that this is the oligopoly market with has a high potential for establishing of a collective monopoly. Only the market leaders have the opportunity to influence the price level.

The Gini coefficient quantitatively interprets the Lorentz graph; the higher the Gini coefficient, the greater the uneven distribution of market shares between buyers and, consequently, the higher the level of concentration.

The Gini coefficient is calculated with the formula:

$$G = \sum_{i=1}^{n} F_{n-1} \times S_n - F_n \times S_{n-1}, \quad (8)$$

where S_n is the cumulative value of shares of secondary steel purchase.

F_n – the cumulative value of the secondary steel purchase shares, provided that the distribution is even.

The results of calculations of the Gini coefficient for the Ukrainian secondary steel market in 2018 are shown in Table. 4.

Table 3

The market share entropy calculation for the Ukrainian secondary steel market in 2018

Name of a metallurgical plant	Market share (S_i)	$1 / S\_i$	$\ln 1 / S\_i$	$S\_i \ln 1 / S\_i$
PJSC AZOVSTAL IRON AND STEEL WORKS	0,22	4,63	1,53	0,33
JSC INTERPIPE DNEPROVTORMET	0,20	5,08	1,62	0,32
PJSC ARCELORMITTAL KRYVYI RIH	0,19	5,33	1,67	0,31
PJSC DNEPROVSKY IRON & STEEL INTEGRATED WORKS	0,14	7,34	1,99	0,27
LLC ELEKTROSTAL-KURAKHOVO	0,10	9,52	2,25	0,24
PJSC ZAPORIZHSTAL	0,06	15,66	2,75	0,18
PJSC ILYICH IRON AND WORKS OF MARIUPOL	0,04	26,74	3,29	0,12
PRJSC DNIPROSPETSSTAL	0,03	32,14	3,47	0,11
PJSC ENERGOMASHSPETSSTAL	0,01	75,26	4,32	0,06
PJSC DMP	0,01	81,21	4,40	0,05
	1,00			1,99

Source: calculated and systematized by the authors according to the source [6]

Table 4

The calculation of the Gini coefficient for the Ukrainian secondary steel market in 2018

Name of a metallurgical plant	S_i	S_n	$1 / n$	$F_n \times S_{n-1}$	$F_{n-1} \times S_n$	G
PJSC AZOVSTAL IRON AND STEEL WORKS	0,22	0,22	0,10	0,04		-0,04
JSC INTERPIPE DNEPROVTORMET	0,20	0,41	0,20	0,12	0,04	-0,08
PJSC ARCELORMITTAL KRYVYI RIH	0,19	0,60	0,30	0,22	0,12	-0,10
PJSC DNEPROVSKY IRON & STEEL INTEGRATED WORKS	0,14	0,74	0,40	0,34	0,24	-0,10
LLC ELEKTROSTAL-KURAKHOVO	0,10	0,84	0,50	0,45	0,37	-0,08
PJSC ZAPORIZHSTAL	0,06	0,91	0,60	0,57	0,51	-0,06
PJSC ILYICH IRON AND WORKS OF MARIUPOL	0,04	0,94	0,70	0,68	0,63	-0,05
PRJSC DNIPROSPETSSTAL	0,03	0,97	0,80	0,79	0,75	-0,04
PJSC ENERGOMASHSPETSSTAL	0,01	0,99	0,90	0,90	0,88	-0,02
PJSC DMP	0,01	1,00	1,00		0,99	0,99
Total	1,00	Gini coefficient	4,11	4,53	0,42	

Source: calculated and systematized by the authors according to the source [6]

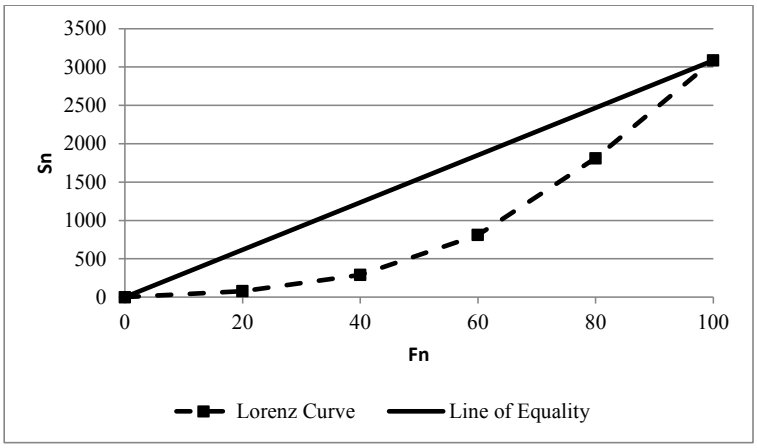

Fig. 1. Lorentz curve for the Ukrainian secondary steel market in 2018

Source: calculated and systematized by the authors according to the source [6]

To draw the Lorentz curve (according to Table 1), we prerank all market participants from the smallest to the largest one by the share of market scrap steel purchases. Thus, the deviation of the Lorentz curve from the line of even distribution characterizes the degree of intensity of competition.

To conclude, the Gini coefficient (G) for the secondary steel market in 2018 is 0.42, and the Lorentz curve indicates that there is a moderate level of shares distribution on this market.

Conclusions. One of the key factors of competitiveness of Ukrainian metallurgical plants, that procure and process scrap metal, is the level of management quality and implementation of high-quality logistics systems. Having analyzed the conditions of the competitive environment in the Ukrainian secondary steel market in 2018, we can conclude that the market is moderately concentrated and oligopolistic; mergers and acquisitions are allowed in the market. Despite that, the market is characterized by a small number of interdependent metallurgical enterprises, a high level of barriers for entry for new players, a high likelihood of collective monopoly. The calculations provide an opportunity to control the ratio of competing forces in the secondary steel market timely, to determine the likelihood of market monopolization, to analyze of the strengths and weaknesses of the company.

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