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Assessment of the Competitive Trends in the Development of Production Business in the Main Segments of the World Steel Market

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Abstract—The variants of efficiency of strategic development of competitive relations in the production and external trading areas of business are assessed in the world steel market and its segments. Reasonability of the developed proposals is demonstrated for scheduling the business activities of metallurgical manufacturers in modern economic environment.

Keywords: world steel market and its territorial segments, pure strategy of business development, statistical and integral indices, steel products

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From the 1950s to date, the development of industrial economy characterized by changes of technological modes (Kondratiev cycles) has been accompanied by an increase in the production of steel as the major structural material of human civilization (Fig. 1) [1, 2]. Herewith, the rates of change of the amount of steelmaking were different in different time periods.

In the considered 70 year time period, which is comparable with the duration of the Kondratiev cycle, the achieved increase in steel production in the world nearly by 10 times was stipulated by intensive development of aircraft engineering, spacecraft, nuclear and conventional power industry, new types of transport systems, electronics and innovative means of communication, industrial and civil construction, as well as other metal intensive industries. The mentioned transformations in the world were accompanied by changes in not only technological modes but also in the structure, the content and business activities of personnel of metallurgical enterprises, and the transnational activity of overall metallurgical business was expanded. Moreover, the main segments of the world metal market were transformed, which was stipulated by the changes in political and economic situation in the world: disintegration of block of socialist countries and the Soviet Union, establishment of independent countries, which started to enter into various economic, political, and military unions, increase in transboundary capital flows on the world market goods and services. However, despite these changes, the main segments of steel market generated according geographical principles in the 1980s in fact remained up till now. Herewith, their

operational performances were seriously adjusted stipulated by actual operation of leading metallurgical companies and changes of world leaders of steel production. The existing segments of the world steel markets are presented as follows: European Union (28), other European Countries, CIS, North America, South America, Africa, Middle East, Asia, and Oceania. Each of the known segments of the world steel market is characterized by specific production subsystem closely related with the steel business on the world market of metal products.

While using the macroscopic approach to the analysis of development of complex industrial and economic system [3], it should be mentioned that these segments could be considered as system elements of the world steel market. Let us assume that the indices characterizing metal flows in these segments are the order parameters, varying in self-organizing system of the world steel market, and the relatively constant steady modes are presented by fixed amounts of monetary funds intended and transferred for production of metal products and its exchange among market counteragents. Under such assumptions, it is possible to estimate the conditions of changes in the metal flows in the industrial and foreign trading areas of market business activity. The time distribution of the average indices of transfer (movement) of metal in industrial and export/import areas would change provided that the conditions of discreteness of money payments are satisfied. If distribution fluctuations are steady (i.e., the order parameters exceed their critical values), this leads to transformation of the existing market struc-

Fig. 1. Change of (a) technological modes and (b) steelmaking at the turn of the 20th and the 21st centuries [1, 2].

ture of the considered industrial and business structure reflecting the business activity in the world steel market and in its territorial segments.

It is known that, near the points of unsteady development of system, the information referring to the order parameters sharply changes, whereas the information of subordinated modes is not exposed to such changes [3, p. 112]. In this work, the data on amounts of steel production and export/import operation in various segments of the modern world steel market are used as parameters characterizing control system impact on the situation on the world steel market. In the course of analysis, the opportunity of strategic development of competitive relations is estimated in industrial and foreign trading areas of business activity on the global steel market.

Figure 1b illustrates the changes in the steel production in the world from 1950 to 2018 and in the turn of the 20th and the 21st centuries, when the main segments of steel market were being transformed. Three periods can be highlighted in this nearly 40 year interval, characterizing the changes in the positions of participants on the market, namely, metallurgical holdings, companies, and enterprises manufacturing metal products in the main segments of the world steel market: (1) before 1991 (period of formation and monopoly positioning of the Soviet Union on the steel market), (2) 1992–2008 (period of establishment of CIS segment and strengthening of the Asian segment of steel manufactures), and (3) 2009–2018 (period of monopoly positioning of China in this market and the impact of global economic crisis and stagnation on the world economy).

The irregular distribution of the data on steelmaking in these periods demonstrates the influence of production, economic, and market factors in various segments of the world market on the total amount of

steelmaking. An analysis of the published data demonstrated that the formation of main segments of the steel market progressed rather dynamically nearly to the commencement of the economic crisis in South East Asia and technical default in Russia in 1997–1998 [4–6]. Up to 1998 various final data were presented for the European Union countries (EU10, EU12, EU15, EU25, EU27, EU28), other European countries, the Soviet Union, CIS, North and South Americas, Africa, Middle East, and Asia and Oceania (cumulative and separate variants). In fact, starting from 1998–1999, the official reports of World Steel Association (WSA) highlighted nine main segments of the world steel market [4, 5]. The statistic data for these segments are summarized in Table 1. These indices characterize the order parameters of self-organizing system. Data distribution for making, export, and import in 1998–2018 are illustrated in Fig. 2.

Figure 2 depicts the respective indices close to normal distribution, as well as displacement of maximum of their frequency distributions towards increase by 20–50 rel % for the time periods before and after the 2008–2009 crisis. This indicates at important changes of market conditions peculiar for the state of production and export/import operations in the considered strategic time periods. The subsequent analysis of the given statistic data for the nine market segments revealed that these indices varied in sufficiently wide range. For instance, for European Union the lowest deviations equaled to –15 rel %, whereas for Asia the highest deviation was up to +135 rel %. Wide range of variations of the considered indices made it possible to conclude that the self regulation of the world steel production was determined by the changes in flow of steel products in the main segments of the world market. This flow was controlled by the capital movement upon satisfying demand for steel products in various segments of the world market of goods and services.

Table 1. Changes in the steel transfer indices on the world market and its segments, the t*

1. From 1999 to 2008													
Market segment	Index	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	$k_i = k_{\text{cr}} / k_{\text{let}}$	$K = \sqrt[3]{k_s k_e k_i}$
European Union 27	Steelmaking	182185	193387	187452	188246	192511	202478	195580	206965	209732	197999	0.9328	0.8505
	Export	116827	127289	124455	127181	131391	144598	141143	155260	161782	158574	0.8582	
	Import	106601	116629	114927	115130	119218	131509	127580	156079	171504	159115	0.7686	
Other European countries	Steelmaking	16147	17014	17697	19265	21281	23992	24972	28205	30608	31760	0.7271	0.6675
	Export	10227	10169	13236	7602	13875	16537	16184	13367	11616	23328	0.5835	
	Import	9354	12579	11315	11738	13268	14151	16744	19364	21533	20952	0.7012	
CIS	Steelmaking	85657	98489	99699	101214	106470	113362	113206	119906	124169	114136	0.8668	0.7537
	Export	50962	54643	54875	58095	59955	64364	63331	67395	66438	63455	0.8954	
	Import	5047	5425	5432	4681	7790	8974	10090	13020	16811	15466	0.5516	
North America	Steelmaking	130044	135353	119858	122949	126161	134021	127631	131789	132618	124515	0.9493	0.8086
	Export	16088	17347	15335	16945	19144	20005	22120	21927	22788	25831	0.7647	
	Import	43687	51377	41759	46240	36592	50526	49107	64762	45566	42400	0.7288	
South America	Steelmaking	34594	39110	37372	40861	43047	45875	45316	45298	48232	47463	0.8856	0.7627
	Export	13487	13400	13508	16981	17101	15955	17362	16082	13768	11753	0.8604	
	Import	4109	5250	5849	4523	5387	4658	5911	8568	9103	11063	0.5823	
Africa	Steelmaking	12818	13827	14916	15807	16289	16706	17995	18780	18755	17088	0.8678	0.7812
	Export	5182	5612	5623	5807	7033	6762	6903	6132	4888	3769	0.8205	
	Import	7984	8770	10037	11474	11853	12454	14574	14994	13584	18558	0.6696	
Middle East	Steelmaking	9779	10780	11690	12492	13443	14253	15257	15576	16452	16646	0.8180	0.6877
	Export	1721	1773	1944	1830	2429	2472	2630	3204	2138	2420	0.7041	
	Import	10234	12235	16552	17338	21208	21474	24675	26654	31861	39204	0.5648	
Asia	Steelmaking	309105	333144	354529	395046	442316	512521	595533	672252	756473	768923	0.6684	0.7279
	Export	63059	74119	70435	77403	80856	94497	100690	133503	150486	143347	0.6568	
	Import	76826	85522	85310	100032	114686	116024	111915	103049	112466	113619	0.8786	
Oceania	Steelmaking	8946	7832	7859	8292	8397	8300	8646	8691	8783	8424	0.9408	0.6726
	Export	3241	2172	973	1272	1141	979	936	1414	1472	1786	0.4747	
	Import	1711	1590	1715	1918	2464	2720	2949	2758	2840	3554	0.6814	
World market	Steelmaking	789275	848934	851073	904170	969915	1071508	1144136	1247236	1345822	1326955	0.7801	0.8056
	Export	280791	306524	300385	313117	332924	366169	371299	418285	435374	434262	0.8174	
	Import	265553	299378	292895	313074	332466	362490	363547	409249	425268	423932	0.8201	

Table 1. (Contd.)

2. From 2009 to 2018

Market segment	Index	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	$k_i = k_{\text{ref}} / k_{\text{ref}}$	$K = \sqrt[3]{k_g k_e k_i}$
European Union 28	Steelmaking	139432	172909	177791	168589	166390	169215	166298	162224	168515	167655	0.9331	0.8979
	Export	112917	134708	145576	139850	134571	140255	140070	141019	147965	147063	0.9353	
	Import	101847	125845	138813	123687	122891	132402	139784	149311	156216	163237	0.8294	
Other European countries	Steelmaking	29034	33650	39079	39917	38627	38374	35778	37601	42203	42441	0.8875	0.8494
	Export	20544	20162	20779	21920	20531	19499	18567	19005	20281	23952	0.8568	
	Import	15129	18617	15566	16621	19534	19016	23998	22988	21838	20135	0.8060	
CIS	Steelmaking	97691	108200	112663	110739	108408	106079	101552	102108	101195	100919	0.9315	0.8989
	Export	57232	57728	55582	55164	51836	53978	51693	54199	50729	52650	0.9352	
	Import	11380	12899	15397	16771	16522	16048	11266	11095	13840	14636	0.8339	
North America	Steelmaking	83772	111562	118675	121586	118978	121093	110938	110638	115386	120879	0.9322	0.8681
	Export	18135	24234	25506	24732	24138	23823	20245	19569	22423	21335	0.8787	
	Import	29836	41786	47556	52750	50195	64664	59090	53156	60816	56789	0.7989	
South America	Steelmaking	37776	43888	48165	46379	45822	45043	43900	40587	44106	44947	0.9147	0.8474
	Export	11152	10854	13145	11307	9428	11121	14613	14342	16453	14696	0.7725	
	Import	8077	14838	13491	13085	14291	15066	14225	11750	12472	12480	0.8613	
Africa	Steelmaking	15400	16624	15696	15337	15963	14885	13701	13099	14818	17390	0.8793	0.8275
	Export	4025	4586	4481	3440	4089	3712	2823	3183	4278	4672	0.8409	
	Import	23821	18537	19235	21602	25441	27692	31128	29704	23369	18027	0.7663	
Middle East	Steelmaking	17766	20000	23230	24979	26967	29986	29429	31480	34475	38037	0.7265	0.6239
	Export	1415	1898	2856	1951	2494	4172	6241	11777	13694	16726	0.3779	
	Import	30508	33870	33786	33572	27184	28572	28530	33007	26271	24277	0.8844	
Asia	Steelmaking	811865	918450	995475	1027114	1123680	1140987	1114224	1125522	1205487	1278002	0.8404	0.8293
	Export	103481	136489	148881	156586	164398	199875	212003	212735	185896	175268	0.7970	
	Import	104768	117281	117696	120414	122668	135749	141538	149780	133916	131908	0.8517	
Oceania	Steelmaking	6014	8149	7248	5805	5888	5466	5717	5837	5985	6341	0.7663	0.7384
	Export	1205	2066	1858	1066	1107	970	1188	965	1171	1222	0.6204	
	Import	2495	3074	2788	3348	2696	3496	3438	2550	2862	2861	0.8469	
World market	Steelmaking	1238749	1433432	1538021	156044	1650423	1671128	1621537	1629096	1732171	1816611	0.8747	0.8920
	Export	330106	392725	418663	416017	412592	457406	467441	476792	462890	457583	0.9002	
	Import	327862	386747	404329	401851	401423	442704	452996	463342	451600	444350	0.9015	

* Initial data by years are from the WSA report [2, 4, 5].

Fig. 2. Distribution of data on the world production, export, and import of steel in various periods at the turn of the 20th and the 21st centuries: (1) 1999–2008 and (2) 2009–2018.

The control action on this market was really being adjusted at governmental or intergovernmental level. It was actually impossible for single companies to exert a significant effect on the world market due to comparatively low production amounts in comparison with the world indices. Collective impact on the market conditions could be exposed only by Chinese metallurgical holdings from the Top 50 steel manufacturers [7]. Therefore, real manufacturers should reasonably take into account the situation in specific market segment, and then, maintaining balanced position in production and export/import business, actively perform the decisions made by the company management aimed at strengthening of positions in respective segment of the world market of goods and services.

The data [8] describe a close interrelation between the world indices of steelmaking and consumption and the results of export/import operations with steel products. With consideration for these results, this work estimates the strategies of efficiency of production development and export/import operations in the main segments of the world steel market. The analysis is based on the changes of indices characterizing production amounts of liquid steel in these segments and on the world market in 2009–2018 [6]. Competitive advantages of various variants of business activity were estimated using the generalized Hurwitz criterion ($G_{(p)}$), which reflects the functions of efficiency of

pure and possible mixed strategies of steel production, import, and export (in tons). The calculations are made according to the procedure described in [9] using the data of Table 1 and the reports [5, 6]. The optimum strategy was determined by the highest index of the pure strategy (G_i). The obtained results are shown in Fig. 3.

It follows from Fig. 3 that, in production sphere, the transfer of steel products in recent decade was at leading positions in comparison with export/import area of metal products in various segments of the world market except for Middle East, where import prevailed over production and export operations (see Fig. 3g). The strategy of manufacture development of wide range of products from steel and alloys at the world level most completely complied with the demands of the world economy in these main structural materials. During the previous decade the international commercial operations were a supplemental element of the market of goods and services upon satisfaction of the demand of buyers and consumers of metal products. In 2009–2018, as in the previous decade, the modern manufacturers nearly completely satisfied the market demands in steel products, which is evidenced by the data on the world steel production, apparent consumption and trends of their future development (Fig. 4).

Fig. 3. Efficiency of the pure strategies of steel product transfer on the world market and its segments in (1) 1999–2008 and (2) 2009–2018: (a) European Union, (b) other European countries, (c) CIS, (d) North America, (e) South America, (f) Africa, (g) Middle East, (h) Asia, (i) Oceania, and (j) overall world. The columns from left to right, steelmaking and export and import of steel products.

Fig. 4. World production and consumption of steel in (a–c) 1999–2008 and (d–f) 2009–2018: (a) $V_{app.steel\ cons} = 42981 + 0.951V_{melt.steel}$ (coefficient of correlation is 0.999); (b) $V_{melt.steel} = 679248 + 67391.8t$; (c) $V_{app.steel\ cons} = 687750 + 64347.9t$ (reference point is 1999), t is time, years; (d) $V_{app.steel\ cons} = -79057.8 + 1.052V_{melt.steel}$ (coefficient of correlation 0.999); (e) $V_{melt.steel} = 1324120 + 48189.6t$; and (f) $V_{app.steel\ cons} = 1309270 + 51439.4t$ (reference point is 2009).

The efficiency of production and consumption of steel products is known to depend significantly on the conditions of balance between production and export/import operations on the market. The equilibrium of metal flow on the world market and its seg-

ments was estimated by integral index of steel transfer (K). This generalized index was calculated as average geometric value by the equation $K = \sqrt[3]{k_s k_e k_i}$, where k_s , k_e , k_i are coefficients equaling to the ratio of the average to maximum indices characterizing steelmak-

Fig. 5. Changes in the integral index of steel transfer on the world market and its segments before and after the 2008–2009 world crisis: (a) actual data, absolute value; (b) relative change, rel %.

ing, export, and import, respectively. The initial and estimated results are summarized in Table 1 and Fig. 5.

During the time period of 1999–2018, a comparison of the integral indices of steel transfer in production and export/import business (Table 1, Fig. 5) revealed an increase in equilibrium of flow of steel products on the world market and most of its segments, except for Middle East. After the 2008–2009 world crisis, the integral index of steel transfer on the world market increased from 0.8056 to 0.8920, i.e., by 10.7 rel %. This is stipulated by the fact that in the main segments of manufacturers and active participants in foreign trading operations this coefficient was higher than 0.8. The highest increase (up to +27.3 rel %) in the integral index of steel transfer was observed in the segment of other European countries, the highest decrease by –9.3 rel % was in the segment of Middle East. The mentioned changes are stipulated mainly by high volatility of production and export/import indices before and after the 2008–2009 crisis, which accompanied the changes of their absolute values in the considered time periods. Therefore, the integral index of steel transfer, being a certain indicator of stabilization and changes of product flow on the world market and its segments, was used at rather illustrative estimation of dynamics in the strategic period of development of the steel market.

It should be mentioned that the obvious trend of increasing the production business in comparison with the foreign trade area was determined by the indices of Asian market segment. For such segments as European Union, CIS, North America, South America, and Oceania, the industrial trend was distinguished by a decrease in the index characterizing efficiency of pure strategies of transfer of steel products.

However, this trend did not exert negative impact on the total segment harmonicity of flow of steel products, which was characterized by high (higher than 0.8) integral index of steel transfer (see Fig. 5a). The change in export and import flows of steel in the men-

tioned segments before and after the 2008–2009 crisis was, probably, determined not only by market factors but also by restrictive measures of impact on foreign trade operations by numerous countries, mainly USA and European Union. In recent decade the sharp decrease in the integral index of steel transfer in the segment of Middle East was influenced by political and military conflicts in this region. A combination of these factors influenced the steel transfer on the world market. Thus, it was possible to conclude that, upon an analysis of possibilities of development of market situation, it would be reasonable to pay peculiar attention to social and political factors, which can influence a market situation. This is especially important at present in the period of the so-called global turbulence characterized by sharp changes in energy prices, fall of stock indices, political confrontation between the leaders of states and alliances, as well as the coronavirus pandemic and respective reduction of business activity in various countries and development of measures of economy development under the new existing crisis situations [10, 11]. The possibility of occurrence of new global economic crisis in 2020, initiated by the coronavirus pandemic, is an additional stimulating factor for rapid performance of studies devoted to selection and estimation of efficiency of development of competitive trends related with activation of business in production and foreign trade areas of business in the world steel market and its segments. The obtained results of this work are intended for solving the challenging problems in the filed of strategic planning and positive realization of partnership relations between the participants in the transactions on the world commodity market under modern conditions.

REFERENCES

1. *Report by Malinetskii about the Potential of the Russian Federation* (2009). <http://www.nanonewsnet.ru/articles/2009/georgii-malinetskii-doklad-o-perspektivakh-rf>. Cited March 5, 2020.

2. *World Steel in Figures 2019* (World Steel Association Brussels, Belgium, 2019). <https://www.worldsteel.org/en/dam/jcr:96d7a585-e6b2-4d63-b943-4cd9ab621a91/World%20Steel%20in%20Figures%202019.pdf>. Cited March 5, 2020.
3. H. Haken. *Information and Self-Organization: A Macroscopic Approach to Complex Systems* (Springer, Berlin, 1988).
4. *Worldsteel Association. Crude Steel Production, 1980–2014* <https://ru.scribd.com/document/298016844/Steel-Annually-1980-2014>. Cited March 5, 2020.
5. *Steel Statistical Yearbook 2009. Worldsteel Committee on Economic Studies* (Brussels, 2010). <https://www.worldsteel.org/steel-by-topic/statistics.html>. Cited March 5, 2020.
6. *Steel Statistical Yearbook 2019. Concise Version. World Steel Association. Economics Committee* (Brussels, 2019). <https://www.worldsteel.org/steel-by-topic/statistics.html>. Cited March 5, 2020.
7. *Top Steelmakers in 2018 List of Companies with Tonnage of More Than 3 Million in 2018*. https://www.worldsteel.org/en/dam/jcr:80ce948e-6a12-47d0-baf1-26799888db67/2018%20Top%20Steel%20Producers_Extended%20List.pdf. Cited March 5, 2020.
8. S. V. Bogdanov, I. Yu. Morozov, and T. V. Bogdanova, “The influence of production factors and export/import metal trading operations on the state of world steel market under modern conditions,” *Elektrometallurgiya*, No. 3, 34–40 (2019).
9. S. V. Bogdanov and S. Yu. Nechaev, “Comparison of strategic competitive initiatives of Russian banking and metallurgical business in modern economic environment,” *Elektrometallurgiya*, No. 12, 28–35 (2018).
10. “Mishustin requested to develop measures on development of economic under the coronavirus conditions,” *News. Russia. Economy*. https://rueconomics.ru/433204-mishustin-poruchil-razrabotat-mery-po-razvitiyu-ekonomiki-v-svyazi-s-koronavirusom?utm_source=yxnews&utm_medium=desktop&utm_referrer=https%3A%2F%2Fyandex.ru%2Fnews. Cited March 5, 2020.
11. Maslennikov, “Five minutes before ideal storm in world economy,” *Economy Today. World. Finances*. <https://rueconomics.ru/433182-maslennikov-do-idealno-go-shtorma-v-mirovoi-ekonomike-ostalos-pyat-minut>. Cited March 5, 2020.

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