Chapter 12
Market Structure of Crude Steel Industry and India's Position in the Era of Globalization

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Introduction

Crucial to the development of any modern economy, steel is a product of large and technologically complex industry having strong forward and backward linkages in terms of material flow and income generation. All major industrial economies are characterized by the existence of strong steel industry and the growth of many of these economies has been largely shaped by the strength of the steel industries in their initial stages of development. So being at the center of attraction, in a situation of high growth of world economy, the steel industry is likely to have a bright prospect. Expanding automobile industry, transportation, and infrastructural projects, linkages of steel industry with different sectors, and crude steel being the first tier of steel making process it becomes extremely important to focus on this industry for analyzing the status as well as trend.

In the era of globalization, the steel industry and its market structure have and are undergoing seismic change. With competition considered as one of the founding principles of globalization, it is conjectured that globalization would lead to greater competition that would evidently be marked by efficiency gain. We interrogate this claim with respect to crude steel across various countries and try to find out whether the opening up of crude steel to global competition across countries leads to a growing competition or concentration. Our results are somewhat counter-intuitive since we find a divergence from the mentioned conjecture, namely that global crude steel market shows evidence of growing concentration instead of greater competition. In this regard, Herfindahl–Hirschman Index (H) is used to identify the changing market pattern of global crude steel from moderate concentration to high concentration. Results indicate that while China has emerged as the major global power in this market, India too is becoming an important

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player albeit still far behind China. I shall end my discussion by briefly examining India's new position in the global crude steel industry and the challenges it faces in the post-globalization phase.

Changing Global Crude Steel Market Structure

The industry went through one of its most difficult phases between 1997 and 2001, as it faced severe recession in the global economy leading to imbalance among capacity, demand, and production. Break up of USSR and Asian Financial Crisis created a significant impact on crude steel industry worldwide. Before that USSR was huge net importers of crude steel. Due to disintegration of USSR, many new countries came into existence and some had turned to net exporter of crude steel.[1] On the other hand, due to Asian financial turmoil, demand of steel within the effected countries fell. These events coupled with similar developments across the world led to a situation where producers had much higher capacity than they could sell. Prices of steel during this period touched a 20-year low (with Hot Rolling Steel going below $200 mark in 2001[2]) and most producers made heavy losses. Many companies were forced to shutdown leading to massive redundancies. New capacities became uneconomical and excess. Fresh expansion plans had to be abandoned as financial sector withdrew support from the steel sector. The period also witnessed major steel producing nations resorting to tariff and non-tariff barriers to safeguard their domestic industry. Pushed to the wall, by 2001, advanced countries were forced to call for a global agreement organized by the OECD to limit the world output of steel and stem the slide in steel prices.

Nevertheless, there were a few "winners" in this difficult environment, and this led the World Steel Dynamics (WSD) to identify for the first time the "world-class" steel makers in the post-globalization phase. By that time, the pricing environment had improved dramatically and WSD could confidently identify companies that deserve to be called "world-class steel makers". It was spelled out that management in each case has implemented changes in the structure of the company that seem to position it well for the future. The importance of this announcement was that these companies in effect were, from then on, to be considered as setting the benchmark for other steel makers in their home countries and internationally. This information also became the benchmark through which it was possible to identify the relative competitive strength of countries in the steel market and which ones were and are emerging stronger. The companies that WSD has selected in 2005 are:

[1] *Source* http://jpcindiansteel.nic.in/profile.asp.

[2] *Source* http://www.steelonthenet.com/kb/world-hot-rolled-coil-prices-2001-2010.html.

- One in Australia—Blue Scope Steel.
- Two in Brazil—CSN and Gerdau *(Note*: *CST, which had also been listed as a "world class" steel maker, was recently merged into Arcelor).*
- Three in the European Union—Arcelor, Corus, and Thyssen/Krupp.
- One in Canada—Dofasco.
- Five in China—Anshan, Baosteel, Maanshan, Shagang, and Wuhan.
- One in India—Tata Steel.
- Two in Japan—Nippon Steel and JFE.
- One in Russia—Severstal.
- One in South Korea—POSCO.
- One in Taiwan—China Steel.
- Three in the United States—Nucor, SDI, and United States Steel. International Steel Group (ISG) was removed from the list after being acquired by Mittal Steel.
- One global company—Mittal Steel, with operations in Algeria, Canada, Czech Republic, France, Germany, Hungary, Indonesia, Kazakhstan, Macedonia, Mexico, Poland, Romania, South Africa, Trinidad, and the United States.

14 out of 22 major crude steel producers are from India China, Japan, US, Russia, Germany, and South Korea. Therefore, we concentrate our analysis in these seven major players.

Objective of the Study

In order to analyze the changing market structure of global crude steel industry, the period from 1995 to 2011 is considered and an attempt made to explore whether global crude steel industry is exhibiting increased competition or is it producing consolidation and concentration. Further this paper is also analyzing position of Indian crude steel industry within this global market.

Literature Review

Existing literatures give the idea of different concentration ratios (Sleuwaegen and Dehandschutter 1986; Schmalensee 1977; Kelly 1981). Of particular importance is the paper by Sleuwaegen and Dehandschutter (1986). Sleuwaegen and Dehandschutter made an analysis on k firm concentration ratio (C_k) and Herfindahl–Hirschman Index (H). These measures can be helpful to determine the market structure of crude steel, that is, in finding out whether the market exhibits concentration or competition. In their study k denoted the largest firm. They made the analysis on US (1956) and Belgian (1981) industrial data and concluded that there was a horn-shaped relationship between the two ratios. Implication of the

conclusion is that if number k increases then that implies lower concentration within the industry on which both indices are calculated. Here between C_k and H any one can be chosen. But for lower k, industry will be highly concentrated and under this situation H is a superior measure of concentration. Consequently, H is acceptable under any circumstances as a measure of market concentration. We can consider this H Index to reveal the changing crude steel market structure in global context.

Several literatures use H index to measure the concentration of different industry like North American steel plate industry, Vermont's retail food industry, US life insurance industry, respectively (David Cummins et al. 1972; Cotterill 1986; Maasoumi et al. 2002). Maasoumi et al. (2002) used H to measure the market power in the context of antitrust litigation in the Steel Plate Industry of North America in late 1990s. It concluded that steel plate market was not subjected to anti competitive forces.

From the review of literature it is clear that none of the previous studies use H in global context in their respective field of analysis. For example, in one study, H index was used in case of US Life Insurance Industry to measure the market pattern but analysis was not made by combining US Life Insurance Industry and Global Insurance Industry (David Cummins et al. 1972). Furthermore, the literature that analyzed steel industry and tried to find out the market structure of steel mainly focused on specific finished steel product.

As such, no analysis is available on crude steel market structure or on the global nature of the market structure of crude steel which additionally marks the distinctiveness of my intervention. Given the distinctness of my focus and methodology, I intend to explore now whether global crude steel market structure is competitive or concentrated and, in that context, throw light on India's position in the crude steel industry.

Methodology and Data Source

As mentioned earlier, Herfindahl–Hirschman Index (H) can be used to identify the changing market pattern of global crude steel. Calculation of H will help to resolve whether Global Crude Steel Industry follows the general conjecture of globalization or not. Herfindahl Index (Herfindahl—Hirschman Index or H) is a measure of the size of firms in relationship to the industry and an indicator of competition among them. It is defined as the sum of the squares of the market shares of each individual firm.

$$H = \sum_{i=1}^{n} (s_i^2)$$

where, s_i is the market share of firm 'i' in the market and 'n' is the number of firms.

Three possibilities arise:

$H < 0.1$ implies unconcentrated index.
$0.1 < H < 0.18$ implies moderate concentration.
$H > 0.18$ implies high concentration.
Source (Maasoumi et al. 2002)

This is normalized Herfindahl Index.

Another form of this Index is:

$$H = (1/n) + n.V$$

where, V is Statistical Variance of the firms' share.

$$V = \left[\sum_{i=1}^{n} (s_i - 1/n)^2\right]/\mathrm{n}$$

In a special case if all firms have equal (identical) shares (that is, if the market structure is completely symmetric) in which case $s_i = (1/n)$ for all i, then $V = 0$ and $H = (1/n)$. But in a more generalized version, firms contribute unequally i.e., market is asymmetric. So there will be a significant gap between s_i and $(1/n)$, in which case V and therefore H will be high. In this paper, H index has been used to examine the market pattern of global crude steel industry.

If the number of firms in the market is held constant then a higher variance due to higher level of asymmetry among firms' shares will result in high Index value. In the global context, major crude steel producing countries can be considered as firms and world crude steel production as industry contribution. Here, India is one of the major crude steel producers.

H Index can be constructed from crude steel production data. Information on global players can be obtained from World Steel Association Data Base presented in "Metal Bulletin Research, Ferro Alloy Monthly Report" (Issue 195, November 2008). This can be further supported by Annual Reports of SAIL and TATA.

Empirical Evidences

14 out of 22 major crude steel producers are from India China, Japan, US, Russia, Germany, and South Korea. Therefore, we concentrate our analysis in these seven major players (Table 12.1).

Now each country's market share (s_i) is calculated in Appendix I, Table 12.2 by dividing each country's production by the world's crude steel production. As seven major players are considered, $(1/n) = (1/7)$. Calculation of $(s_i - (1/n))$, its square, sum of its squares is shown in Appendix I Table 12.3. V and H are calculated in Appendix II, Tables 12.4 and 12.5, respectively.

Over the period, global crude steel industry is shown to be growing with a fast changing scenario. From Appendix 1 Table 12.2 it can be seen that Japan, US, and Russia, the key players of 1995, were unable to retain their position. Share in global crude steel production falls from 13.5053 % in 1995 to 7.2210 % in 2011 in case of Japan, from 12.6545 % in 1995 to 5.7848 % in 2011 for US and for Russia it falls from 6.8590 % in 1995 to 4.6104 % in 2011. On the other hand when most of the key players' share slides, China and India has shown an upswing in their share in global crude steel output. Thus, within 1995 and 2011, share in world crude steel production of every nation falls except India and China.

Considering theoretical background of H index, here H has been used to reestablish the changing global crude steel market structure. V is calculated to get the values of H index.

Values of Herfindahl Index (H) are plotted against years in Appendix II, Graph 12.1. If the trajectory of the graph is followed then it is clear that in the year 2001, index value exceeds 0.18 i.e., in this particular year crude steel market starts to become highly concentrated. 2009 is the year of maximum concentration. There is a change in the world crude steel market structure from moderate concentration to high concentration, where 2001 seems to suggest the edge of this change. Therefore, years of globalization seem to have flattened competition somewhat leading to a more concentrated industry structure in the post-globalization phase. Another important point that comes from this analysis is that China has evolved into a crude steel giant through this transformation. Even in the phase of global meltdown in 2008 China retained remarkable share of total world crude steel output which many suggests was due to the Beijing Olympics. By no means comparable to China yet, one also cannot ignore the growing importance of India in that industry.

Position of India in Global Crude Steel Industry

The above study makes it clear that China and India has emerged as major competitors. In 1950, both the Indian and Chinese steel industries were producing finished steel at a rate of about 1 million tons per year . From that point until about the mid-1990s, the Indian steel industry grew at a much slower rate, expanding at an annual rate of 6.5 % versus approximately 10.3 % for the Chinese steel industry.

From the mid-1990s to 2007, Chinese crude steel production registered a growth of approximately 28.48 % whereas India registered that of 10.38 % (*Source* World Steel Association, World Steel in Figures 2010) Even over the period 2008 and 2009, India's crude steel production grew at the rate of 2.7 % vis-à-vis 13.5 % that of China (*Source* World Steel Association, World Steel in Figures 2010). This only factualizes the rapid emergence of China as a dominant crude steel player within the world. It is presumed that the growth of the Indian

steel industry and its share of global crude steel production could be even higher if they were not being held back by major deficiencies in fundamental areas. Investment in infrastructure is rising appreciably but remains well below the target levels set by the government due to financing problems.

Deficiencies in Indian Crude Steel Industry

Energy Supply

Power shortages hamper production at many locations. Since 2001, the Indian government has been endeavoring to ensure that power is available nationwide by 2012, albeit not very successfully. The deficiencies have prompted many firms with heavier energy demands to opt for producing electricity with their own industrial generators.

Problems Procuring Raw Material Inputs

Since domestic raw material sources are insufficient to supply the Indian steel industry, a considerable amount of raw materials has to be imported. For example, iron ore deposits are not adequate and there are problems in mining sufficient amounts of it. India's hard coal deposits are of low quality which has led to increase in hard coal imports. The rising output of electric steel is also leading to a sharp increase in demand for steel scrap. In the coming years imports are likely to continue to increase, thanks to capacity increases.

Inefficient Transport System

In India, insufficient freight capacity and a transport infrastructure that have long been inadequate are becoming increasingly serious impediments to steel development. Although the country has one of the world's biggest transport networks—the rail network is twice as extensive as China's—its poor quality hinders the efficient supply of goods. The story of transport bottleneck stretches to port facilities and airports.

Growth Opportunities in Indian Crude Steel Industry

Although China is the world's largest crude steel producer, its export potential may not be as great as overall production might suggest, due to its relatively small number of efficient producers (Baosha, Wuhan, Anshan, Shougang to name a few). China is not a significant exporter of steel as they have focused on domestic

market. In a study (Meta Bulletin Research Battelle) it was mentioned that, given average finished steel production, China consumes 96 % of finished steel. Per capita Steel consumption is low by international standard, but it is growing, showing an increase from 60 kg in 1990 to 100 kg in 1998. In 1998 the total consumption of steel exceeds 125 million MT per year. With such a large and growing steel market China not only absorbs most of its own production but is a net importer. Most finished steel production that China exports go to regional markets of Asia implying China does not yet consistently meet the international product standard.

This indicates that India has opportunity to become a substantial exporter. Indeed, over the past few years, the gap between production and domestic consumption in India suggests that India is becoming a net exporter. One cannot deny joint support extended by Central and State government to exploit country's natural resources and that would help India to strengthen its position in global crude steel market. This also may facilitate strong sustainable growth in India's crude steel industry. Moreover, the high level of competition to get ownership of iron ore reserves probably favors domestic companies since they better understand the bureaucratic and legal complexities that need to be negotiated. Interestingly, not only are existing and fledgling steel mills vying for the ore; state-owned mining and trading companies also want access to it, and then to develop new mines, perhaps, on a joint venture basis. Better cost position as compared to offshore firms also helps India. Going forward, India's lower wages and favorable energy prices will continue to promise substantial cost advantages compared to production facilities in (Western) Europe or the US. The growth prospects of the client industries are also very good. The deployment of modern production systems is increasingly enabling India to improve the quality of its steel products and thus to enhance its export prospects. However, as we mentioned earlier, the challenges too are formidable.

Conclusion

This paper explored the changing global crude steel market structure through Herfindahl–Hirschman Index. Our result points to market concentration and concludes that China has emerged as a dominant player in terms of crude steel production. While, in comparison to the pre-liberalization and pre-globalization period, India is becoming prominent in World Crude Steel market, it still lags far behind China. Infrastructural bottlenecks fettering investment seem to be holding back its true growth potential.

Appendix I

Table 12.1 Crude steel output (Million Tones)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
India	22	23.8	24.4	23.5	24.3	26.9	27.3	28.8	31.8	32.6	38.8
China	95.4	101.2	108.9	114.6	124	127.2	150.9	182.2	222.4	280.5	348.06
Japan	101.6	98.8	104.6	93.6	94.2	106.4	102.9	107.8	110.5	112.7	112.47
South Korea	36.8	38.9	42.6	39.9	41	43.1	43.9	45.4	46.3	47.5	47.7
Germany	42.1	39.8	45	44.1	42.1	46.4	44.8	45	44.8	46.4	44.51
US	95.2	95.5	98.5	98.7	97.4	101.8	90.1	91.6	93.7	99.7	93.09
Russia	51.6	49.3	48.5	43.8	51.5	59.1	59	59.8	61.5	65.6	64.34
World	752.3	750	798.9	777.3	789	847.7	850.3	903.8	969.1	1067	1102.9

	2006	2007	2008	2009	2010	2011
India	42.62	49.39	57.8	62.8	68.3	72.2
China	421.46	487.63	500.3	573.6	626.7	683.3
Japan	116.22	120.2	118.7	87.5	109.6	107.6
South Korea	48.53	51.18	53.6	48.6	58.5	68
Germany	47.22	48.54	45.8	32.7	43.8	44.3
US	98.54	98.21	91.4	58.2	80.6	86.2
Russia	70.47	72.49	68.5	60	66.9	68.7
World	1215.04	1309.31	1326.5	1219.7	1413.6	1490.1

Source Metal Bulletin Research, Ferro Alloys Monthly, Issue 195, November 2008
http://en.wikipedia.org/wiki/List_of_countries_by_steel_production (based on data provided by World Steel association)

Table 12.2 Share (%) of each nation in world crude steel output i.e. s_i

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
India	2.9244	3.1733	3.0542	3.0233	3.0798	3.1733	3.2106	3.1865	3.2814	3.0553	3.5179
China	12.6811	13.4933	13.6312	14.7433	15.7161	15.0053	17.7467	20.1593	22.9491	26.2887	31.5578
Japan	13.5053	13.1733	13.0930	12.0417	11.9392	12.5516	12.1016	11.9274	11.4023	10.5623	10.1974
South Korea	4.8917	5.1867	5.3323	5.1332	5.1965	5.0843	5.1629	5.0232	4.7776	4.4517	4.3248
Germany	5.5962	5.3067	5.6327	5.6735	5.3359	5.4736	5.2687	4.9790	4.6228	4.3486	4.0356
US	12.6545	12.7333	12.3295	12.6978	12.3447	12.0090	10.5963	10.1350	9.6688	9.3440	8.4402
Russia	6.8590	6.5733	6.0708	5.6349	6.5272	6.9718	6.9387	6.6165	6.3461	6.1481	5.8336

	2006	2007	2008	2009	2010	2011
India	3.5077	3.7722	4.3573	5.1488	4.8316	4.8453
China	34.6869	37.2433	37.7158	47.0280	44.3336	45.8560
Japan	9.5651	9.1804	8.9484	7.1739	7.7533	7.2210
South Korea	3.9941	3.9089	4.0407	3.9846	4.1384	4.5635
Germany	3.8863	3.7073	3.4527	2.6810	3.0985	2.9730
US	8.1100	7.5009	6.8903	4.7717	5.7018	5.7848
Russia	5.7998	5.5365	5.1640	4.9192	4.7326	4.6104

Table 12.3 Calculation of $((S_i - (1/n))^2)$

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
India	0.01291	0.01235	0.01261	0.01268	0.01256	0.01235	0.01227	0.01232	0.01211	0.01261	0.01159
China	0.00026	0.00006	0.00004	0.00002	0.00020	0.00005	0.00120	0.00345	0.00751	0.01441	0.02983
Japan	0.00006	0.00012	0.00014	0.00050	0.00055	0.00030	0.00048	0.00056	0.00083	0.00139	0.00167
South Korea	0.00882	0.00828	0.00802	0.00838	0.00826	0.00847	0.00832	0.00858	0.00904	0.00967	0.00992
Germany	0.00755	0.00806	0.00749	0.00742	0.00801	0.00777	0.00813	0.00866	0.00934	0.00987	0.01051
US	0.00027	0.00024	0.00038	0.00025	0.00038	0.00052	0.00136	0.00172	0.00213	0.00244	0.00342
Russia	0.00552	0.00595	0.00675	0.00748	0.00602	0.00535	0.00540	0.00588	0.00630	0.00662	0.00714
Total	0.03538	0.03507	0.03543	0.03674	0.03598	0.03480	0.03715	0.04117	0.04726	0.05702	0.07409

	2006	2007	2008	2009	2010	2011
India	0.01162	0.01105	0.00986	0.00835	0.00894	0.00891
China	0.04162	0.05270	0.05490	0.10721	0.09029	0.09967
Japan	0.00223	0.00261	0.00285	0.00506	0.00427	0.00499
South Korea	0.01059	0.01077	0.01050	0.01061	0.01030	0.00945
Germany	0.01081	0.01119	0.01174	0.01347	0.01252	0.01280
US	0.00381	0.00460	0.00547	0.00905	0.00737	0.00723
Russia	0.00720	0.00765	0.00832	0.00877	0.00913	0.00936
Total	0.08789	0.10058	0.10362	0.16251	0.14280	0.15241

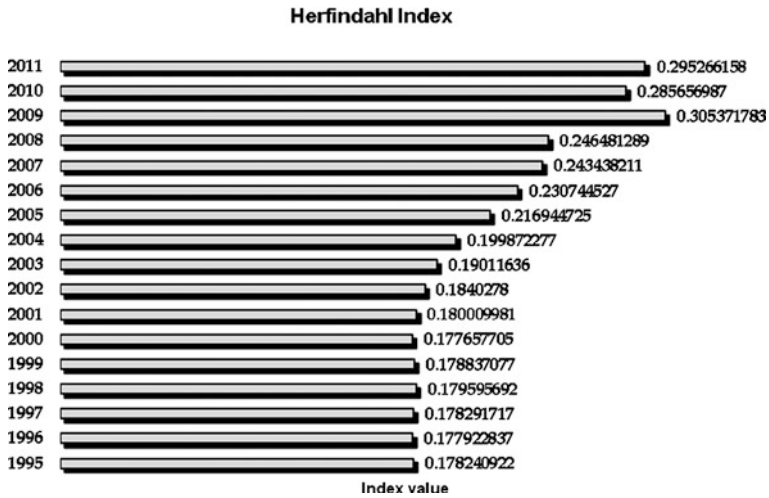
Appendix II

Table 12.4 $V = [\text{Sum}\{((S_i\text{-}(1/n))^2)\}/n]$

1995	0.005054826
1996	0.005009385
1997	0.005062082
1998	0.005248364
1999	0.005139991
2000	0.004971509
2001	0.005307548
2002	0.005881522
2003	0.006751317
2004	0.008145019
2005	0.01058394
2006	0.012555341
2007	0.014368724
2008	0.014803449
2009	0.023216377
2010	0.020399978
2011	0.021772716

Table 12.5 $H = (1/n) + n*V$

1995	0.178240922
1996	0.177922837
1997	0.178291717
1998	0.179595692
1999	0.178837077
2000	0.177657705
2001	0.180009981
2002	0.1840278
2003	0.19011636
2004	0.199872277
2005	0.216944725
2006	0.230744527
2007	0.243438211
2008	0.246481289
2009	0.305371783
2010	0.285656987
2011	0.295266158



Graph 12.1 Crude Steel Market & Herfindahl Index

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