

China's Iron and Steel Industry — History, Development Trend, and Policy Implications*

Haohao LI** · Chung Weon YOON*** · Wanpeng CHENG**** · Fangfang SHU*****

Abstract

China has become a huge producer as well as a huge consumer of steel, and it has been ranked No.1 in steel production since 1996. A huge demand for steel guarantees the steady development of the iron and steel industry for the next 10 to 20 years. While China's steel industry is faced with many urgent and difficult problems, such as difficulties in iron ore negotiations, low concentration ratios, high energy consumption, environmental pollution and irrational product mix, the global financial crisis, has made it more urgent that these difficulties and problems be solved. In this paper, the author holds that to improve iron ore negotiations, China requires revoking the import licenses of enterprises and authorizing an institution to be in charge of the import of iron ore, introducing a competition mechanism to split the oligopoly at the same time. It is advisable for China to increase the government investment on and strengthen the exploitation of foreign resources in order to reduce reliance on the big three mining companies. Additionally, to increase industry concentration, it is suggested that China's steel industry implement a strategy of integration, and strengthen annexation and reorganization of steel industries. At last, China's steel enterprises needs to enhance innovative abilities to solve such problems as high energy consumption, environment pollution and irrational product mix.

* 논문접수일 2009년 12월 4일, 게재확정일 2009년 12월 17일

** Professor, Department of Applied Economics, School of Business, University of Shanghai for Science and Technology, Shanghai, China.

*** Professor, Department of International Trade, College of Commerce, Chonbuk National University, Jeonju, Republic of Korea.

**** Graduate student for doctoral course, Department of International Trade, Graduate School, Chonbuk National University, Jeonju, Republic of Korea.

***** Graduate student, Department of Applied Economics, School of Business, University of Shanghai for Science and Technology, Shanghai, China.

Keyword: China, International Negotiation, Reorganization, Integration, Independent Innovation Ability

I . Introduction

In 2009, the People's Republic of China and China's steel industry both celebrated their 60-year anniversary. 60 years ago, China's steel industry was undeveloped, but it has overcome many hardships and difficulties, and has grown into the largest producer and consumer of steel in the world. Since entering the 21st century, China's iron and steel industry developed fast and achieved great success. However, it is faced with urgent difficulties and problems, which have become more serious under the impact of the global financial crisis. This paper firstly reviews the history of China's steel industry and backs up the viewpoint that the high demand for steel will continue for quite a long time in China. Then it analyzes reasons of the difficulty China faces in iron and steel industry in the iron ore negotiation and puts forward policies. After that, the paper discusses about the necessity and difficulties in the reorganization and integration of China's iron and steel industry. Through the discussion, the authors argue that China needs to find its own way to develop steel industry, taking into account its actual situation, but not put too much emphasis on improving the concentration ratio of China's steel industry. At last, to improve independent innovation ability of China's iron and steel industry, and change China into a powerful country in iron and steel production, it is advisable for China to pay attention to construct internal and external environment beneficial to independent innovation, green development, and the cultivation of numerous professional, experienced and creative talents.

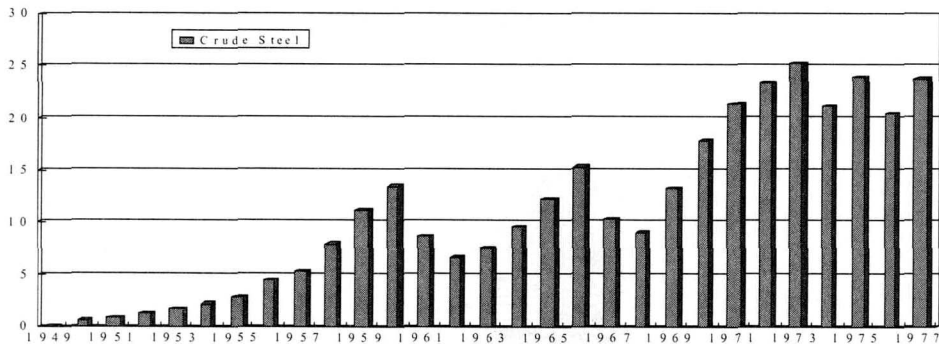
II . History and recent status of China's steel industry

2.1 Overview of development history since 1949

China's steel industry was undeveloped in 1949, when crude steel output in the

mainland was only 158,000 tons, which was less than that of Luxemburg. To 1957, China's steel industry, having experienced a short period of steady growth, increased its crude steel output to 5.35 million tons. In the following 20 years, constant domestic political campaigns influenced the development of the steel industry. During that time, it was in an unstable state with major fluctuations (Figure 2-1).

With the reform and opening up of China, and the determination of national policy focusing on economic construction, China's steel industry began developing steadily at the end of the 1970s. In 1978, the crude steel output was over 30 million tons, in 1986, over 50 million tons, and in 1996, over 100 million tons (Table 2-1). In the 21st century, China's steel industry rapidly expanded. In 2001, the crude steel output was over 150 million tons, in 2003, over 200 million tons, in 2005, over 350 million tons, and by 2008, over 500 million tons. After the establishment of People's Republic of China, it took 47 years to realize 100 million tons of the annual crude steel output. It then took less than 7 years to realize over 200 million tons. And 5 years later, it had increased to 500 million tons (Table 2-1 and Figure 2-2).



<Figure 2-1> Crude steel output of China (1949-1977, million tons)

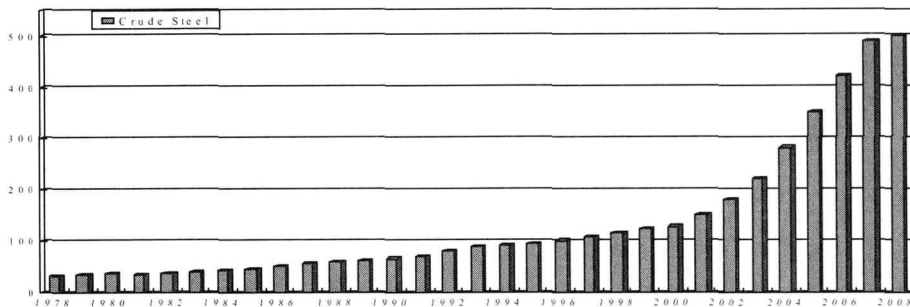
Source: National Bureau of Statistics of China

Year	Crude Steel Output (million tons)	Year	Crude Steel Output (million tons)
1978	31.78	2003	222.34
1986	52.20	2005	353.10
1996	101.24	2006	422.66
2001	151.63	2008	501.16

<Table 2-1> China's Crude Steel Output in Key years

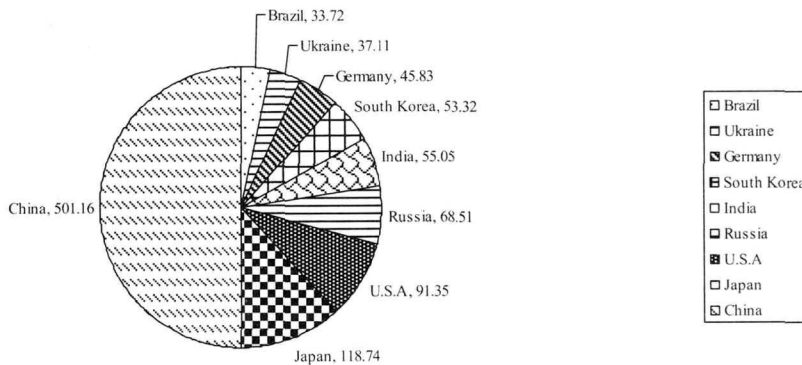
Source: National Bureau of Statistics of China

Since 1996, China has been the largest producer of iron and steel in the world. In 2008, China's crude steel output of iron and steel industry was 38% of the total output of the world; China produced 501.16 million tons, while next eight nations produced a total of 503.63 million tons (Figure 2-3).



<Figure 2-2> Crude steel output of China (1978-2008, million tons)

Source: National Bureau of Statistics of China



<Figure 2-3> Top 9 states in crude steel production (million tons)

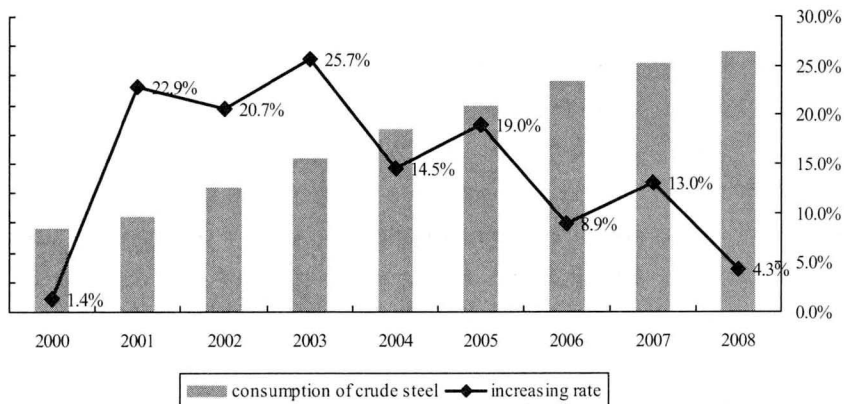
Source: Qun Zhang (2009)

2.2 Recent development trend

China's iron and steel industry has been developed with the growth of GDP and rise of people's living standard. In 1978, with \$362.4 billion of GDP, China had problems in feeding, clothing, and sheltering most of its population, but it begins to make preparations for its industrialization. In 1986, with its GDP increasing to \$1,020.1 billion and crude steel output to 52.20 million tons, it could supply adequate food and clothing to most citizens, which was the basis for the rapid development of industry. In 1996, with GDP up to \$7,117.7 billion and iron and steel output at 101.2 million tons, the socioeconomic development reached a new level, at which the problems listed above had been largely solved.

The 21st century is a new period of rapid economic and social development for China. In 2001, China's GDP was over \$10 trillion and crude steel output over 150 million tons. In 2003, China's per-capita GDP was more than \$1,000 and crude steel output was over 220 million tons. Within the six years from 2003 to 2008, China's GDP exceeded \$20 trillion and then \$30 trillion, per-capita GDP accordingly exceeded \$2,000 and \$3,000, and crude steel output was firstly over 300 million tons, then over 400 million tons and at last over 500 million tons.

China's huge demand has driven the rapid growth of iron and steel output and its productivity in recent years (Figure 2-4) . As for the unreasonable factors, it will be discussed later.



<Figure 2-4> China's consumption of crude steel from 2000 to 2008

Source: Q. Zhang (2009)

With the remarkable development of China's society and economy, like the example of

the consumption patterns of developed countries, people's demand for improved living conditions is growing dramatically, and needs to be met urgently. Within a very short time, most urban residents and a growing number of rural residents began to consume products, a substantial number of which were made all, or in large part, of iron and steel, such as household appliances, cars, housing and so on.

With an ever increasing GDP the potential demand for steel is greater in China, given the size of population, than developed economies.

China is in a special period of rapid urbanization, in which the per-capita demand for iron and steel is unparalleled compared with that of developed countries. It is estimated that there will be 0.4 billion people migrating from rural to urban areas in the next 10 to 20 years. In 2007, the per-capita living area of urban residents was 27.1 square meters, according to these estimates a further 11 billion square meters of housing, at least, will be required. If taking natural growth of population into consideration, the demand for housing will be greater. The demand on vehicles for transportation and household appliances will increase. What's more, such infrastructural facilities as railway, highway and airport and so on, are under construction on a large scale. All these support the estimate of a steady huge demand for iron and steel in the next 10 to 20 years.

The above conclusions can be verified in two ways: 1) The annual per-capita consumption of steel of industrialized countries is 500 kilograms, so China which has a population of 1.3 billion will consume 0.65 billion tons of steel every year; 2) The cumulative per-capita consumption of steel of developed countries is 20 tons. It took the United States 76 years from 1900 to 1975 and Japan 56 years from 1945 to 2000 to complete the industrialization and move into post-industrialization period. While until 2008, China's cumulative per-capita consumption of steel was only 3.4 tons and it will take at least 20 years for China to reach the world level. As a result, the high demand for steel will continue for quite a long period of time in China.

2.3 China's recent import status of iron ore

As the iron and steel industry is the foundation of the national economy, and iron ore is the main raw material of a steel industry, a stable supply of iron ore directly

relates with the sustainable development China's iron and steel industry and affects the performance of the national economy. In 2009, failed in the iron ore negotiation and the purchase of foreign resources, China's iron and steel industry is faced with difficulties, which has attracted much attention from the government, industry, scholars, the public and the media. In this section, the writer will analyze the cause of the trouble and make practical suggestions and measures.

As we have seen, along with the rapid growth of steel output, China's demand for iron ore is increasing. While domestic iron ore resources can not meet the demand of China's iron and steel industries in quantity as well as quality, China has led to the high ratio of dependence of foreign iron ore resources. Pig iron made from foreign iron ore accounted for less than 10% of the total output of the whole country, in 1981, when China began to import iron ore. Since 1996, when the crude steel output broke through 0.1 billion tons, the ratio of pig iron made from imported iron ore has increased rapidly. In 2004, it went up to over 50% and more than 70% in the first half of 2009.(Table 2-2)

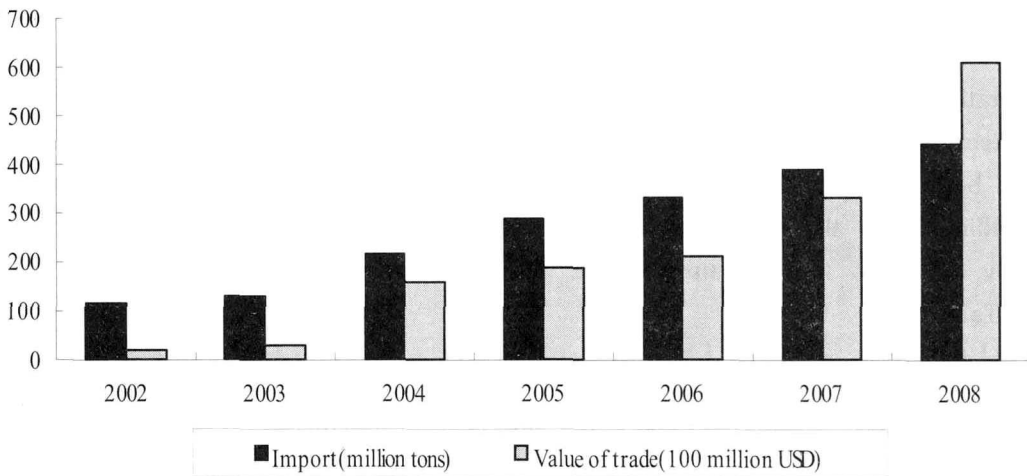
Year	Iron ore import	Up percentage from the same period of last year	import iron ore production	Total pig steel production	Proportion of import iron ore production to the total pig iron output
1981	3.3364		2.1525	34.17	6.30
1986	12.0046	18.79	7.7449	50.64	15.29
1990	14.1912	14.34	915.56	62.37	14.68
1995	41.1500	10.20	26.5484	105.29	25.21
2000	69.9700	26.60	45.1400	131.01	34.46
2001	92.3100	31.92	59.5500	155.54	38.29
2002	111.5000	20.79	71.9300	170.85	42.12
2003	148.1300	32.86	95.5700	213.67	44.73
2004	208.0900	40.48	135.2600	268.31	50.41
2005	275.2600	32.28	177.5900	343.75	51.66
2006	326.3000	18.54	210.5200	412.45	51.04
2007	383.0900	17.40	247.1500	469.93	52.60
2008	443.6600	15.81	286.2300	470.67	60.81

<Table 2-2> China's import of iron ore and its production and ratio (million tons, %)

Source: (CISA)

China has become the largest international iron ore importer. In 2008, it imported 444

million tons of iron ore, accounting for 52% of the international iron ore which was achieved through maritime transportation; Japan imported 105 million tons, accounting for 12.3%; Korea imported 49.54 million tons, accounting for 6%. China imported 183 million tons iron ore from Australia and 100 million tons from Brazil. The total import from the two countries accounts for 64% of China iron ore import, but China does not have a voice in the negotiation with iron mining giants.



<Figure 2-5> The iron ore import and trade value of China from 2002 to 2008

Source: China Iron and Steel Association (CISA),
Global Entrepreneur, No. 14, July 20, 2009

III. The causes of problems China faces in iron and steel industry

In the iron ore negotiation, the long-term contract price and foreign direct investment, including equity investment, on oversea iron ore production enterprises will be discussed. The reasons for the difficulty facing China's iron and steel industry in the iron ore negotiation are as follow.

3.1 Domestic aspects

Firstly, with low concentration ratio, Baosteel and CISA can not play the role of representative of China iron and steel industries.

Reality has been proved that no one, including Baosteel and CISA, are competent for the role of representative. Therefore, it is necessary to learn more about China's iron and steel industry, Such as the number of enterprises and their size. At present, there are more than 2,000 iron and steel enterprises in China, including 73 large-scale companies and other small and middle enterprises(SMEs), with low concentration ratio (it will be discussed later) . According to current import regulations, 73 large enterprises and another 39 traders qualify for iron ore imports, while other small and medium enterprises (SMEs) are unable to.

Baosteel, the representative of China iron and steel enterprises, can not coordinate the interests among other enterprises, especially of the SMEs, and can not resolve the internal contradiction in the iron and steel industry. The large-scale iron and steel enterprises lead the products price in the domestic market, to a certain extent, with the ability to pass on the cost of production. Therefore, when Baosteel represents the China iron and steel industries, negotiating with the three biggest suppliers, its target price is not necessarily optimal for the whole industry.

What's more, they can resell the imported iron ore to the small and middle iron and steel enterprises at a relatively higher price to make certain profits. This further weakens the impartiality of Baosteel, who represents the interests of large-scale enterprises, to strive for the best price. It well explains why China has to passively accept the three suppliers' offer, when the imports account for more than half of the world seaborne iron ore.

The CISA, representing China's iron and steel enterprises in negotiating with the three miners in 2009, can not overcome all defects, either, because of its administration background and lack of professionalism. What's more, it can not really represent the interests of all iron and steel enterprises, either. The precursor of CISA is the Ministry of National Metallurgical Industry which was revoked in 1998. It decided that the CISA, with strong administration background, may have different goals from that of iron and steel enterprises. In the first negotiation in 2009, because of its lack of professionalism,

it cannot act flexibly and make the right adjustment to reach an agreement with the sellers. With the rising of steel prices and recovery of the steel industry, China missed the best opportunity to sign agreement and its bargaining power is gradually weakening. CISA is a nominal industry association. It is seemingly the natural representative of iron and steel industries, but the decision maker is not from the enterprises. What concerns CISA is different from what the enterprises are worried about. In this way, the enterprises are urgent to sign agreement while CISA is not.

Secondly, China is not lacking in iron ore resources, but the quality of domestic iron ore cannot meet the demand. Australia, Brazil and India have estimated that the average iron content in the ore reserves of the main countries producing iron ore is over 60%, but that in Russia iron ore reserves are 56%, and in China, only 33%. Low grade iron ore must be dressed to be the iron concentrate before smelting. Australian and Brazilian iron ore can meet the demand without dressing, while that mined in other countries can not. That is one of the reasons why China's iron and steel enterprises prefer foreign iron ore.

Thirdly, before 1990, iron ore was mainly exploited by state-owned mining enterprises and was sold at low planned prices. At that time, the price of imported iron ore was higher than that of domestic iron ore, and it was hard to import because only scarce foreign exchange was acceptable. But many state-owned iron and steel enterprises preferred to use foreign iron ore. With the rapid growth of China's iron and steel industry, domestic concentrated iron ore market is growing. Lots of small and middle private iron and steel enterprises emerged, which became the main consumers of domestic iron ore. And the iron ore price was not planned any more but derived by the interaction of supply and demand in the market. In that period, domestic iron ore price rose rapidly, and was absolutely higher than that of import iron ore although they were at the same grade. In 2003, one ton of iron ore cost \$30 on average, and in the third quarter of 2008, it increased to \$140, while the highest price of China native ore was 1,400RMB per ton, equivalent to \$201 per ton. It suggests that low import iron ore price contributed to the development of China's demand market, which leads to the increasing reliance on import iron ore, and the rising of domestic iron ore price, in turn, pulls the import iron ore price. The basic principle of economics tells us price is derived by the interaction of supply and demand and formed in the transaction. So when domestic iron ore price is too high, China will inevitably fall into passive position in the iron ore

price negotiation with overseas iron ore suppliers.

Fourthly, structural problems become a big obstacle recently. Since entering the 21st century, the iron and steel production capacity of China continues to grow rapidly. By the end of 2008, China crude steel capacity of production had amounted to 660 million tons, but the real crude steel output was less than 500 million tons, that means the over-capacity was more than 160 million tons. If compared with the actual consumption of crude steel in 2008, that is 453 million tons, the number of overcapacity will be larger. It is estimated that the capacity of production will be increased by 50 million tons in 2009, which will enlarge the overcapacity in a period.

The number of iron and steel enterprises in China increased rapidly during 2000 to 2006, however the industry concentration ratio declined because there were a large number of small and medium size enterprises in the industry. In 2006, the steel output of the top five steel enterprises accounted for only 24.8% of the national gross output, 10.6 percentage point down in contract with the year 2000.

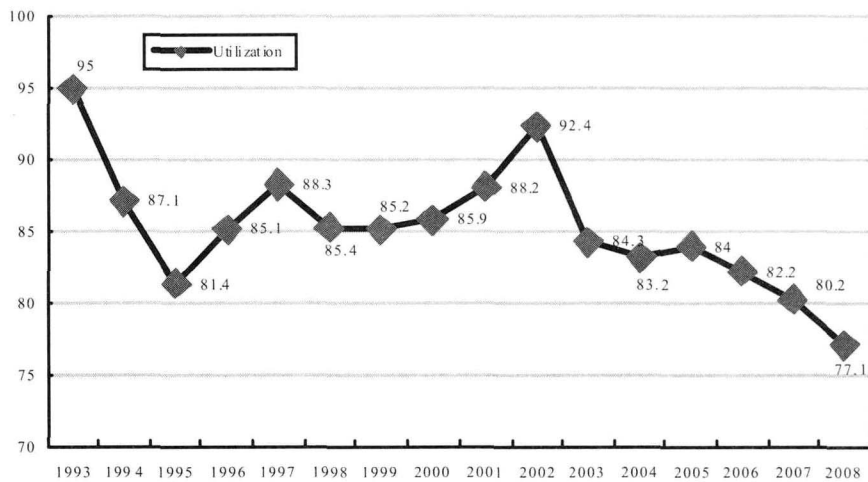
According to the law of technical economy in the iron and steel industry, the ideal production capacity utilization ratio is 85%. From 1993 to 2008, that ratio in China was above 80%, but it went below 80% in 2008 (Figure 3-1), signaling an overcapacity in China's iron and steel industry.

Another problem in China's iron and steel industry is structural overcapacity. There is a robust demand in the market, even exceeding supply in local regions, for building steel like deformed steel bars and wires. These are primarily produced by small and medium size steel enterprises, especially private companies. This lagging production capacity does not comply with the national steel industrial policies and revitalization plan. Meanwhile, the market demand for high technical products like hot rolled coil and cold rolled coil, produced mainly by large-scale iron and steel enterprises, is relatively low.

From the view of technological economy, the rule in the steel industry itself decides the necessity of reorganization and integration. For example, the large smelting equipment used by large-scale enterprises has energy consumption advantages over the smaller equipment used by small and medium size enterprises (Table 3-1). In addition, the larger equipment contributes to environment protection and the realization of a low carbon economy.

From the analysis, we can draw the conclusion of the necessity for the reorganization

and integration of China's iron and steel industry. In addition, three aspects in Chinese government's Blueprint for the Adjustment and Revitalization of the Steel Industry (2009-2012)¹ support this view. First, blind investment and overcapacity of production are serious problems in the iron and steel industry. Second, industry distribution is not rational, with most iron and steel enterprises located in inland large-to-medium sized cities, which results in serious restrictions of environmental capacity, water resources, transportation and energy supply. Third, China's steel industry has a low concentration ratio. The average crude steel output of one corporation is less than one million tons, and the steel output of the top five enterprises only accounts for 28.5% of the total output of the country.



<Figure 3-1> Utilization of production capacity of China's iron & steel industry (1993-2008, %)

Source: China Iron and Steel Association (CISA)

1) State Council of the People's Republic of China, "Blueprint For The Adjustment And Revitalization Of The Steel Industry", Beijing, March 20, 2009. <http://www.gov.cn>

	blast furnace (< 300 m3) converter or electric furnace (< 20 t)	blast furnace (>1,000 m3) converter or electric furnace (>120 t)
energy consumption producing one ton iron	499kgec/t	420kgec/t
power consumption producing one ton steel	500kwh/t	250kwh/t
smoke ,powder and dust emission producing one ton iron	2kg/t	0.1kg/t
SO2 emission producing one ton iron	5.42kg/t	1.23kg/t

<Table 3-1> Differences between small and large equipments

Source: Q. Zhang (2009)

3.2 International aspects

The first one needs to be noticed is that governments of developed countries have prejudice toward China's government and China's enterprises that are state-owned or were transformed from state-owned enterprises.

Developed countries always keep alert on newly developing countries, especially on the dramatic rejuvenation of China, which has a population of 1.3 billion. In many case, they do not treat China as a commercial competitor but as an imaginary enemy. This prejudice and hostility is apparent in the course of China's mergers and acquisitions with overseas resource corporations. Take Aluminum Corporation of China (Chinalco)'s aborted takeover of Rio Tinto as an example.

Chinalco, the backbone of China state-owned enterprises, is a state authorized investment management institution and holding company. By the end of June 2008, the total asset of the company was 377.7 billion Yuan. As the second largest alumina and the third largest aluminum producer, its value retaining and increment rate of fixed assets and net assets income ratio rank at the top of the list of state-owned enterprises with over 10 billion Yuan of assets.

Rio Tinto, established in 1873, the world's second largest mining company, ranked ninth of the top 10 Australia enterprises from 2003 to 2004. Its head office is in Britain

and headquartered in Melbourne in Australia. Of Rio Tinto's business, Australia accounts for 45%, North America 40% and South America 5%. As for sales income of Rio Tinto, North America contributes 28%, Europe 23%, Japan 22%, Australia and New Zealand 4%, China 5%, and other Asian countries 14%.

On 1 Feb 2009, Chinalco said in a London stock exchange announcement that it had acquired a 12 per cent existing stake in Rio Tinto PLC, through Shining Prospect Pte. Ltd of Singapore, a Singapore based entity wholly owned by Aluminum Corp of China Ltd (Chinalco) and into which Alcoa has committed US\$1.2 billion by way of a convertible instrument. The counter-performance in this deal amounted to US\$14.05 billion. It was the largest-scale overseas investment in the history of Chinalco and none of China enterprises had ever launched so large an investment in foreign countries. Chinalco said, in mid-February, that it would invest US\$19.5 billion in Rio Tinto through establishing a joint venture with it and purchasing its convertible bonds. But before the materialization of the deal, it must receive the government approval from China, UK, Australia and US and the antitrust approval from Australia and German. In the meantime, it needed to be approved in the shareholders meeting of Rio Tinto Group. Henceforth, by early June 2009, Chinalco had won US\$21 billion in loans to fund this deal and had gotten the approval of Australian Competition and Consumer Commission (ACCC), the German Federal Cartel Office, and the Committee on Foreign Investment in the United States (CFIUS). However, while Rio Tinto negotiated about modification of the scheme with Chinalco, it met with BHP Billiton secretly and discussed the details to form a joint venture dealing in iron ore production in west Australia. Thanks to Chinalco's decision to inject capital into Rio Tinto and recovery of the financial market, Rio Tinto's financial position improved. Hence, it announced, on 5 Feb 2009, that the board decided to cancel the recommendation for strategic cooperation with Chinalco and suspended the negotiation. And that it had raised US\$15.2 billion through full underwriting of the share placement.

On one hand, the intervention of BHP and RioTinto's betrayal directly caused the collapse of the deal, on the other hand, the Australian government also worried about a China enterprise, with a state owned background, acquiring its strategic assets, so it had exerted pressure to some extent. The collapse of the Rio deal brings up painful memories for China of another failed natural resources foray: offshore oil champion Cnooc Ltd.'s attempt to takeover Unocal Corp. of the U.S.. From the two cases, we

concluded that foreign politicians and entrepreneurs are alert to China's enterprises like Chinalco and China National Offshore Oil Co. and have doubt about their decision-making mechanism, the cost of the acquisition and financing and the developing strategy after the acquisition.

The second cause is extreme asymmetry between the two sides in the negotiation game of iron ore resources

If there are conflicts of interest in a team, the internal unity and consistent force against external foes are in inverse relation to the number of players participating in the game. The fewer the participants, the easier to form a unanimous voice and consistent force against external foes, as Mancur Olson² said, "Smaller groups could act more decisively and use their resources more effectively than large groups: Small centripetally organized groups usually call on and use all their energies, while in large groups, forces remain much oftener potential." Therefore, it is more likely for a centripetally organized group of professionals to gain strength in a negotiation than for a large mixed group with constant conflicts of interest.

One of the two parties in iron ore resource negotiation is comprised of CVRD, Rio Tinto and BHP Billiton, the three biggest iron ore producers, whose combined market share accounted for 75% of the global market in 2006 to reduce themselves to be the high oligopolies in the iron ore market. The other party is made up of China's iron and steel enterprises group. Although they are the largest buyers with a large production capacity, and a low concentration ratio, through internal competition in the industry means that they cannot work in unity in the negotiation. What is more, in the negotiation game, Rio Tinto acquired China's national secrets through illegal means.³ So it is understandable that China did not have a voice in the iron ore long-term contract price negotiation in past years, and it had a little priority in fixing the price.

The last one is the international pricing mechanism of iron ore.⁴ There are two ways

-
- 2) Mancur Olson, "The Logic Of Collective Action: Public Goods And The Theory Of Groups", Harvard University Press, Cambridge, Mass., 20th printing, 2002, p.54
 - 3) In July 2009, Shanghai police detained four employees of Rio Tinto Australian Stern Hu, head of Rio Tinto's Shanghai office, and three China's suspected of spying and stealing secret confidential data of China iron and steel enterprises. Presently, the case is under processing.
 - 4) This section has referred to Jingsong Song's article – Thoughts on import iron ore pricing, China Economic Times, Oct 22, 2009.

for trading iron ore: long-term agreements and the spot exchange. Brazil and Australia take the long term approach setting price in a fiscal year from April 1st to the next March 31st, through annual negotiation. India mainly takes the spot price.

The long-term agreement price negotiation mechanism started in 1981. The negotiation is divided into two parts - the Asian market and the European market. Since 2001, the three biggest iron ore suppliers, Companhia Vale do Rio Doce (CVRD) from Brazil, and BHP Billiton and Rio Tinto from Australia, have negotiated with iron ore purchasing representatives including Japan Nippon Steel Corporation, Korea Pohang Iron and Steel Corporation, and China Baosteel⁵ from the Asian market and, France Arcelor⁶ from Europe.

The negotiating mechanism is based on three principles, one of which is called the "passive accept principle". That is, as soon as any miner reaches agreement with the steel-maker, others have no choice but to accept the outcome. In other words, once any

one of the big three agrees a price with any one of the buyers the annual negotiation is over. All of the countries involved in the iron ore trade have to accept the price without any resistance. Over a 28 year span, from 1981 to 2008, in 17 years the international long-term contract price of iron ore kept rising, and in 10 years of which it kept dropping, and in one year of which the price kept stable. Japan has led the negotiations 13 times and Europe 14 times. In 2003, with China being the largest importer of iron ore, its steelworks now act as a chief negotiator rather than a spectator in the annual global iron ore price negotiations. China, represented by Baosteel, has taken part in the negotiation for 6 years in succession. China has tried to insist on a new principle that quantity should be considered in setting long-term iron ore prices, with a larger discount given for bigger demand. It maintained that as the largest buyer, China requires to have more pricing right, but it failed, and the iron ore price soared by 397.8% (Table 3-2).

5) In 2009, the role was replaced by China Iron and Steel Association (CISA).

6) Arcelor was the second largest steel producer in the world in terms of production. Mittal Steel made its acquisition Arcelor in 2006. ArcelorMittal is the world's number one steel company now.

Fiscal year	time for agreement	The leading party	rising amplitude (%)
2001	2001-3-20	CVRD-Ilva	4.31
2002	2002-5-29	CVRD-TKS ⁷	-2.4
2003	2003-5-19	CVRD-Arcelor	8.9
2004	2004-1-13	CVRD-Arcelor	18.62
2005	2005-2-22	CVRD-Nippon Steel Co.	71.5
2006	2006-5-15	CVRD-TKS	19
2007	2006-12-21	CVRD-Baosteel	9.5
2008	2008-2-18	CVRD- Nippon Steel Co.	65
	2008-6-23	Rio Tinto- Baosteel	79.88 (powder) and 96.5 (lump)
2009	2009-5-26	Rio Tinto- Nippon Steel Co.	-32.95 (powder) and -44.47 (lump)
	2009-9-7	FMG ⁸ - Baosteel	-35.02 (powder) and -50.42 (lump)

Table 3–2 The table of first international long-term contract price of iron ore

Source: <http://www.hywfgg.com.cn>

IV. Suggestions on China's policy in iron and steel industry

4.1 Introducing competition mechanism to split the oligopoly alliance

Virtually, the iron ore price game is a competition between the highly oligopolistic iron ore industry and the highly competitive iron and steel industries. According to Bain, if $CR_{49}^{***} < 30\%$ or $CR_8 < 40\%$ (CR: concentration ratio), then the industry is classified as full competition; if $CR_4 > 75\%$, it is a highly oligopolistic industry.^{10****}

7) TKS represents Thyssen Krupp Steel.

8) FMG represents Fortescue Metals Group Ltd.

9) CR₄ stands for the concentration ratio of the top four enterprises in one industry; CR₈ stands for the concentration ratio of the top eight enterprises in one industry.

10) Bain, J.S, "Industrial Organization", John Wiley: <New York>, 1968.

The iron ore industry is a highly oligopolistic industry with iron ore resources located primarily in Brazil, Australia, Russia, India and China. In 2006, CVRD, Rio Tinto and BHP Billiton contributed 75% of the global iron ore, so they three formed a high oligopoly. Therefore, CVRD played the role of leading the price in the iron ore market, and Rio Tinto and BHP Billiton tacitly followed it. In this way, a cartel was formed to fix a uniform price for the market.

Iron ore distribution is characterized by concentration while steel mills and production are relatively dispersed. Although there are large-scaled enterprises in the iron and steel industry like ArcelorMittal, the international giant in iron and steel industry, who has a steel-production capacity of 120 million tons, and Baosteel with a capacity of 30 million tons, it is difficult for them to transform their advantage in scale into bargaining power. These large iron ore consumers are still weak compared with iron ore producers.

Therefore, as large iron ore importers, the authors recommend that China, Japan and Korea work together to introduce a competition mechanism to split the oligopolistic alliance. For instance, they may negotiate with the three suppliers respectively and choose the two with lower prices. The theory and practice of economics have proved that a price-fixing cartel is not stable. Considering the poor financial situation of CVRD, Rio Tinto and BHP Billiton, it may be possible to split the oligopolistic alliance as they now have an urgent need to improve cash flow.

4.2 Revoking the import licenses of enterprises and authorizing an institution in charge of the import of iron ore

Pursuing maximized profit, iron and steel enterprises are disunited when it comes to iron ore price negotiation. To improve the situation, it is necessary for the China's government to intervene in the market by consolidating the iron ore import market. This will strengthen the bargaining power against the international oligopoly

It is desirable that State Council revokes the import licenses of 112 iron and steel enterprises and traders, and authorize the Ministry of Commerce to be in charge of the establishment of a monopolistic stock iron ore import enterprise, which will be the only legitimate iron ore importer in China. China needs to allocate shares in accordance with the approved level of steel output, hold a shareholder's meeting and establish a board

of directors on that basis. Every shareholder will have an indirect right to import iron ore through this new enterprise. As the only iron ore importer in China, it can control the import amount more easily and avoid loss resulting from disunity. Meanwhile, it can better implement the state macro-control over the iron and steel industry.

4.3 Increasing equity investment and enhancing exploitation of foreign mine resources

While improving the concentration ratio and the level of monopolistic competition, China iron and steel enterprises need to realize industry vertical integration by sharing or holding foreign iron ore companies. In this way, their bargaining power in the negotiation will be improved and the profit margin will be increased.

The global financial crisis offers China's enterprises a rare opportunity to obtain foreign iron ore resources, stabilize the cost of iron ore and disintegrate the oligopoly of iron ore. The financial crisis has resulted in a slump of global resource prices, causing deficits for many resource enterprises. These enterprises may go bankrupt without a new injection of capital. In addition, the financial crisis has reduced political obstacles in the acquisition and the cost.

China can learn from the successful experiences of foreign iron and steel giants. ArcelorMittal has plenty of iron ore resources all over the world, and its self-supply rate of iron ore amounts to 50% and increasing to 60% in the future. Nippon Steel Co., the representative of Japanese iron and steel enterprises, imports over 0.1 billion tons of iron ore every year, of which, over 74 million tons come from their own mines. Of the 24 largest iron ore mines in Australia, Japanese companies control eight. They also hold shares of other iron ore mines. China's large enterprises, for example Baosteel, also have invested in overseas ore mines. It is expected in the future that other China's iron and steel enterprises will follow ArcelorMittal and Nippon Steel Co to invest in overseas ore mines directly and extend the industry chain upward.

Additionally, the authors recommend that China, Japan and Korea, all primary iron ore importers, strengthen communication and exchange of ideas on the iron ore long-term contract price negotiation, striving for a price favorable to all.

It is expectable that foreign and China iron and steel industries will gradually realize

merger and reorganization. They aim to achieve equal status in negotiations with the iron ore oligopoly and to disintegrate the cartel of CVRD, Rio Tinto and BHP Billiton. Along with the disintegration of cartel, the growth of demand for iron ore decreasing, iron ore price will go down and the development space of the iron and steel industry will be expanded.

4.4 Reorganizing and integrating iron and steel industry

During 100 years from the early 20th century to 2008 when global financial crisis happened, the international iron and steel industry has experienced 4 periods of acquisition and integration. In the early 20th century in America, J. P. Morgan consolidated 785 small and medium size steel enterprises to create the United States Steel Corporation, which accounts for 70% of America's steel output. In the 1970s, Yawata Works and Fuji Steel, the sixth and tenth largest producers in the world at that time, merged to form Nippon Steel Corporation. In the 1990s in Western Europe, in the process of European integration, the steel industry underwent a wave of mergers and acquisitions between companies and groups, which resulted in the European sector being dominated by a few multinational groups such as Arcelor, ThyssenKrup and Corus. In the early 21st century, the fourth wave of mergers happened. The climax of that wave was marked friendly, US\$33.8 billion merger between the two largest producers at the time, Mittal and Arcelor, with the new company to be called Arcelor Mittal.

It is estimated that the reorganization and integration of China's steel industry from 2007 will garner the most attention from the international market in the fifth integration of the global steel industry. Every M&A (merger and acquisition) contributes to the raise of concentration ratio of global steel industry.

In Blueprint for the Adjustment and Revitalization of the Steel Industry, the reorganization and integration of the steel industry may start from transforming its developing mode, with the core ideas of the policy - improving the competitiveness of superior enterprises and phasing out the lagging capacity of production. It covers two aspects: optimization of industry distribution and system innovation.

Subject to the precondition of controlling the total amount, China needs to adjust the structure and optimize distribution of the industry, and have the enterprises phase out

the lagging capacity. It is also desirable that steel mills are moved out of the cities to areas better suited for steel production and transportation. We suggest the relocations should comply with the principle - first, the coastal region, second, the area along Changjiang River, and at last, the inland areas. In addition, it is advisable that the relocations take into account adapting to the resources environment.

System innovation makes it possible to remove all the institutional obstacles, including benefit distribution in finance and taxation, assets allocation, and debt verification and settlement. This carries weight with corporate restructure, so that a beneficial environment can be created to promote the development of corporation of the iron and steel companies and to realize the cross-area, cross-ownership, and cross-trade merger and reorganization. Concretely, it mainly includes the following four aspects¹¹:

In the period from 2009 to 2011, it is advisable that crude steel output stand at about 0.5 billion tons.

Before the end of 2010, update blast furnaces of 300m³ and below, which produce 53.4 million tons of iron. Also, update 20-ton and below converter and electric furnaces, which can produce 3.2 million tons of steel. By the end of 2011, update all other blast furnaces of 300m³ and below and 20-ton and below converter and electric furnaces. Accordingly, 72 million tons of iron production and 25 million tons of steel production will be phased out. In the region where the large iron and steel mills will be built to phase out the lagging capacity of production, the standard will be improved and 1,000 m³ blast furnaces will be updated.

It is recommended for China to possess several super enterprises with strong independent innovation ability and international competitiveness, setting a CR5 for the steel industry at above 40%. The industry distribution is obviously optimized - it is

argued that capacity of production of steel enterprises located in the coastal region and the area along Changjiang River account for 40% of the national production capacity, and pollution by steel enterprises in key central cities will greatly reduce. By 2011, it is estimated that there will be several super steel enterprises with a production capacity over 50 million tons and strong international competitiveness. such as Baosteel, Anshan/Benxi Iron & Steel Group and Wuhan Iron and Steel Co. and so on, large-scale steel enterprises with capacity of production between 10 million and 30 million tons.

11) This part is inducted and summed from Blueprint for the Adjustment and Revitalization of the Steel Industry

4.4.1 The ways for reorganizing and integrating

China's steel industry has to speed up the redistribution of the steel industry without increasing or with decreasing the capacity of production.

Firstly, it has to build a coastal steel base, moving Shougang Group from Beijing to Caofeidian in Tangshan and building a high quality steel base through merger: Baosteel mergers with steel enterprises in Guangdong, Wuhan Iron and Steel Co. did the same with steel enterprises in Guangxi.

Secondly, it has to induct industry transfer orderly and promote industrial consolidation to reduce the urban environmental pollution, moving steel mills out of large cities as Guangzhou, Hangzhou, Hefei, Fushun, Qingdao, Chongqing and Shijiazhuang.

Thirdly, it has to step up the implementation of steel construction projects proposed in the special planning for allocation of productive force and the adjustment of industry, for instance, in reconstruction of Wenchuan after the earthquake and the adjustment of industry.

In fact, in 2007, before the plan was released, China set about reorganizing and integrating the steel industry. According to the China Iron and Steel Association, after one year of effort, in 2008 China's top ten steel enterprises produced 212.7359 million tons of crude steel, 42.5% of the total crude steel output, up 5.71 percent from the previous year. In addition, the concentration ratio of the top five enterprises was up 3.7 percent from 2006.

4.4.2 Difficulties in reorganization

In steel industry integration, China is faced with such non-marketing restrictions as regional barriers, profit distribution and different ownership of enterprises, which have hampered, and will continue to hamper the progress of reorganization and integration. Subsequently, no progress has been made in the acquisition.

4.4.2.1 State-owned asset hierarchic management - one obstacle

Like other state-owned enterprises, the central, provincial and municipal governments hierarchically manage China's state-owned iron and steel enterprises. Governments at all levels directly or indirectly administrate the assets, operation and personnel of steel enterprises. In such a system, reorganization and integration of the enterprises becomes an interest coordination and bargaining game among governments.

4.4.2.2 Contradiction in profit distribution resulting from current fiscal and taxation system - another obstacle

China's current financial management system includes a tax-sharing system and a governmental transfer payment system. Therefore, local governments support the reorganization and integration of local enterprises but take a passive attitude toward trans-regional reorganization and integration. They are concerned that the reorganized enterprise will be relocated outside their region and there will be no contribution from the reorganized enterprise to the fiscal revenue of local government. They prefer a loose business group to reconstruction and integration. Such an attitude comes to be such a big obstacle in the trans-provincial and trans-regional merger between powerful enterprises.

4.4.2.3 Local large-scale iron and steel enterprises lack of enthusiasm to reconstruction and integration

Some powerful local large-scale iron and steel enterprises do not have an interest in reconstruction and integration. They are only interested in expanding their own enterprises. Under the pressure of the government, some enterprises have established different forms of cooperative relationships with others. These include strategic cooperation without reorganizing the inner operation system of the enterprise, or a loose cooperative relationship, not tied by assets. Each enterprise is focused on self-development, duplicating construction, and making it difficult to cooperate or form a combined force to strengthen, expand and upgrade the enterprise.

4.4.3 Implications on reorganization and integration

As a large developing country, the authors advise that China do not place too much emphasis on increasing the concentration ratio of the iron and steel industry. There are

two reasons. First, if the sales network of China's iron and steel covers an area that is too broad, it will increase the production cost of downstream industries. Second, maritime transportation is not so convenient. Therefore, in the reorganization and integration, it is recommended for us to work out how to optimize the regional distribution structure cautiously so that it saves energy, protects the environment, allows sustainable development, helps to form a strong force for resources negotiation, and cultivates the core competitiveness of China's iron and steel enterprises.

Another notable question is the conclusion of the empirical study by Chunli Du (2009) and other scholars on the relationship between scale and benefit, taking the top four iron and steel enterprises - Baosteel, Tangshan Steel Co., Anshan Iron & Steel Group and Wuhan Iron and Steel Co. as the research objects. According to the study, there is a long-term equilibrium but no significant causal relation between the scale and benefit of China's iron and steel enterprises, and the scale economy effect of China's iron and steel enterprises is not apparent^{12*}, for which there are three reasons.

(1) On one hand, the protection policies carried out by local governments lead to the lack of a competition mechanism or natural selection in China's iron and steel enterprises; on the other hand, because of low concentration ratio of the steel industry, it is hard for a large-scale enterprise to acquire monopoly profit and the production cost is increased indirectly. This results in the diseconomy of scale.

(2) In general, a large company enjoys many advantages, including economies of scale, but it is not the case in China. Because reorganization and integration involves the benefit distribution between the central and local governments, in many cases, it is achieved just in form not in nature, which is not helpful to realize the scale economy of the steel enterprises.

(3) After reorganization and integration, the management level of the enterprise is not improved with the expansion of scale, so the benefit of scale expansion is offset by the rising management cost. Thus, scale economy disappears.

(4) Large-scale steel enterprises in China, which mainly produce high added value steel product with high homogeneity, which results in fierce competition and has negative effect on the improvement of enterprise benefit.

12) This part is inducted and summed from Blueprint for the Adjustment and Revitalization of the Steel Industry

4.5 Improving independent innovation ability

After 60 years effort, China has grown into a world steel country, with crude steel output far exceeding that of other countries, ranking no.1 in the world. As for the workmanship, many production lines in China's iron and steel enterprises have employed the most advanced equipment and technology in the world. For example, the production line, 2,250mm wide, for hot rolling of strip, continuous casting and rolling line of sheetbar and so on.

At present, the quality of most steel products in China, such as pipeline steel, bridge steel and ship steel, have reached the most advanced level in the world, except for a few products used in specialized fields. For example, there is a little gap between China's and Japan's automobile sheet steel.

In addition, the independent innovation ability, and use of advanced technology in China is still weak. The development and application of top products is mainly dependent upon introduction and imitation, and much importation of crucial steel products of high quality. This demonstrates that China's consumption structure is at the middle and low level.

As for patent applications, most steel enterprises in China have not applied for patents. Even a key enterprise like Baosteel, has less than 200 patent applications per year, while Nippon Steel Co. and Pohang Works (POSCO) disclose more than 2,000 patents every year. Current phased overcapacity is promoting the development of new products and improvement of equipment and technology. It offers a favorable opportunity to promote the upgrade of the industry, and what is crucial to upgrade the industry is to accelerate independent innovation.

4.6 Constructing internal and external environment beneficial to independent innovation

The lack of a reasonable mechanism that is beneficial to independent innovation is the root cause of limited self-directed innovation capability of China's iron and steel industry. This problem is not unique in the steel industry but is common in China.

China's government has been aware of the problem, and proposed in 2005 that it will

take scientific and technological progress and innovation as the primary driving force of economic and social development. We recommend that China take the improvement of independent innovation ability as the key link of the economic structure adjustment, transformation of economic growth mode and improvement of the competitiveness of the state. Through taking the construction of an innovation-oriented country as a major strategy in the future. China is to develop itself to be an emerging innovator in the future.

It is advisable that, in the next few years, China's iron and steel industry establish a market-oriented technical innovation system featuring enterprises as the core, improve the policy system encouraging innovation, and establish a system, a mechanism and policy environment which conduce to self innovation. China needs to provide practical support for the transformation and promotion of technological innovation projects by strengthening the intellectual property protection.

4.7 Maintaining green development, changing black smelting into green smelting

Contradiction between population and resources and economic development and ecological environment is the dominant factor restricting the modernization of China. Although China has become the largest real economy and manufacturer in the world, its per capita share of resources is lower than that of other countries. With the acceleration of industrialization, the demand for natural resources and raw materials has increased enormously, especially the demand for land, water resource, clean energy resource and mineral products. There is a contradiction between supply and demand. With the most fragile ecological environment, and the largest population in its history, China is challenged by the most unprecedented resource consumption and economic activities.

Reviewing the modernization of Europe, The United States, the former Soviet Union and Japan, their high growth of economy is supported and realized by high consumption of means of subsistence and high waste of resources especially non-renewable resources. Such kind of development may be defined as 'black development'. Now, it is strongly advised to abandon the heavy industrialization mode of the former Soviet Union with high energy consumption, heavy pollution and low

efficiency, and not to imitate the high cost, consumption, emission mode of modernization in Europe and The United States, otherwise, we will exhaust the earth. Therefore, China will develop a new green mode.

According to the Blueprint for the Adjustment and Revitalization of the Steel Industry, China will develop the iron and steel industry under the scientific outlook on development, depending upon scientific and technological progress and following the development of a recycling economy. In this way, we will realize the sound, stable and sustainable development of the steel industry, and promote the realization of the coordinated development between the iron and steel industry and the social and natural environment. Through reducing energy consumption and increasing energy efficiency, we may achieve recycling of raw materials and improve resource efficiency.

4.8 Cultivating numerous professional, experienced and creative talents

The talented person plays an important role in improving the independent innovative ability. It is desirable that China's iron and steel enterprises changes their concept to narrow the gap between China's enterprises and overseas iron and steel enterprises in the introduction and education of talents. On the one hand, it is suggested that China makes better use of international resources, capital, technologies, knowledge, and international talents, and introduce numerous professional, experienced and creative talents from China and overseas countries. On the other, it is necessary for China to pay more attention to the training of personnel and to the improvement of their professional quality, and create a working and living environment that is beneficial to independent innovation, to avoid brain drain.

China's government requires to set up an innovative mechanism to encourage the introduction and cultivation of innovative personnel, and help iron and steel enterprises with the construction of three teams, including innovative entrepreneurs, strategic technicians and professional skilled workers. The following measures are worth considering:

- (1) Attracting innovative talents by some key scientific and technological projects.
- (2) Implementing a flexible policy to introduce more innovative talents from all over the world, allowing them to do a full time job or a part time job, or provide temporary

service in China's iron and steel enterprises.

(3) Subsidizing innovative projects and invention patents of innovative talents, to promote creativity.

(4) More rewards are need to be given to the innovative talents with outstanding performance.

(5) Establishing a system of paid training and sabbatical leave for innovative talents to support the establishment of enterprise training system for the skilled workers, and to encourage private training institutions to participate in the training for skilled workers, which is organized by the government.

V. Conclusion

Through 60 years effort, China has become largest steel producer in the world, but not yet the most powerful one. Now China is in the Middle-to-Later Period of Industrialization, and there is huge demand for iron and steel. Therefore the high demand for steel will continue for quite a long period of time in China.

Although China has become the largest international iron ore buyer, it does not have a voice in the international negotiation with the iron ore giants for many reasons. In this paper, the authors argue that we may take following measures to change such situation: (1) Introducing competition mechanism to split the oligopoly alliance (2) Revoking the import licenses of enterprises and authorizing an institution to be in charge of the import of iron ore (3) Increasing equity investment and enhancing exploitation of foreign mine resources so as to reduce reliance on the big three miners, CVRD, Rio Tinto and BHP Billiton.

Another problem in China's iron and steel industry is that the concentration ratio is relatively low and structural overcapacity exists. China requires reorganizing and integrating the steel industry to improve the competitiveness of superior enterprises, phasing out the lagging capacity of production according to Blueprint for the Adjustment and Revitalization of the Steel Industry. In the course of reorganization and integration, by cautiously working out how to manage the regional distribution structure, China will achieve its goals such as saving energy, protecting the environment, allowing

sustainable development, forming a strong force for recourse negotiation, and cultivating core competitiveness of its own iron and steel enterprises.

In 21st century, one important task for China's steel industry is to improve the independent innovation ability and change China into a powerful country in iron and steel production. Therefore, it is advisable for China to pay more attention on the construction of internal and external environment beneficial to independent innovation, green development, and the cultivation of numerous professional, experienced and creative talents.

Reference

- Yin, Ruiyu(2004), *Review and Prospect of Iron and Steel Industry in China*. Angang Technology. 4, 2004, 1-6
- Li, Shijun(2005), The Development Trend and Strategic Thinking about China's Iron and Steel Industry. *Steel Structure*. 3, 2005, 96-99
- Xu, Yin(2003), Prediction on the Demand for Steel products in 2005 and 2010. *China Steel*. 1, 2003, 16-20
- China Iron and Steel Association(2007), Prediction on the market demand for Steel products in 2010 in China (Abstract)(revision version in 2007). *China Steel*. 9, 2007, 40-50
- Liu, Dong(2009), Status Quo and Analysis of China's Iron Ore Import in Recent Years. *Metal Mine*, 1, 2009, 17-20
- Zheng, Jianming, Sun, Na and He, Wei(2006), Supply and Demand Pattern of Iron Ore, China's position in the market and game strategy. *Macroeconomics*, 8, 2006, 36-39
- Sun, Laihui(2009), Thoughts on How to Gain Advantage in Annual Iron Ore Negotiation. *Science & Technology Information*, 27, 2009, 526-528
- Wang, Shenqiang & Wang Jianguo(2009), *Global Iron Ores Situation and China's Iron Ore Strategy*. Resources and Industries, 2, 2009, 12-17
- Wu, Gongming(2009), The new perspective of merger and acquisition of China's steel enterprises. *Contemporary Economics*, 21, 2009, 12-14
- Zhang, Qun(2009), On Challenges in Iron Ore Resource Negotiation and Development of

- Chinese Iron and Steel Industry. *11th Conference of Management Science of China*, Chengdu, Oct. 16-19, 2009
- Jingsong Song(2009), Thoughts on import iron ore pricing, *China Economic Times*. Oct 22, 2009
- Olson, M.(2002), *The Logic of Collective Action: Public Goods and the Theory of Groups*. Harvard University Press, Cambridge, March 20th printing, 2002.
- Blueprint for the Adjustment and Revitalization of the Steel Industry. Beijing. Mar. 20, 2009. <http://www.gov.cn>
- Bain, J.S.(1968), *Industrial Organization*. John Wiley: New York, 1968.
- Chunli Du, Jinhua Cheng, Weijin Zou(2009), The empirical study on the relationship between scale and benefit of China's iron and steel enterprises. *Statistics and Decision*, No.2, 2009, 79-82
- Yi, Shubiao & Ding, Qijun(2009), Scale Efficiency of Chinese Iron and Steel Enterprises. *Journal of ShanXi Finance and Economics University*, 3, 2009, 51-57
- Peng, Tieli(2007), The Analysis on the expansional Investment Strategies of Baosteel, *Metallurgic economics and management*, 4, 2007, 36-38
- Suo, Guibin & Wang, Yanzeng(2008), Study on the Strengthen Policy of China's Iron and Steel Industry based on Endogenous Innovation and Green Manufacture. *Scientific Management Research*, 4, 2008, 30-33
- Chen, Tao et. al(2006), The Study on the Innovation Environment of China's steel industry. *Metallurgy economics and management*, 6, 2006, 17-19
- <http://www.stats.gov.cn>
- <http://www.chinaisa.org.cn>
- <http://www.hywfgg.com.cn>