China's Steel Industry: Recent Reform Initiatives and their Impact on Enterprise Performance

Oleksandr Movshuk
Research Assistant Professor, ICSEAD, and
Visiting Associate Professor, Graduate School of Economics,
Kyushu University

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Abstract

This paper examines recent trends in production capacity, product mix, technological modernization, and trade propensity of China's iron and steel industry, with a particular emphasis on persistent imbalances between supply and demand for products with low and high value-added content. Major reform initiatives to modernize the industry are discussed, including the conversion of state-owned enterprises into corporate entities, and recent efforts to create internationally competitive steel conglomerates around the largest four steel producers in China (Anshan, Baoshan Shougang, and Wuhan). To evaluate the impact of these recent reform initiatives on enterprise efficiency, the paper reviews major studies that examined the efficiency of Chinese steelmakers, and discusses policy implications of these for reforming this chronically underperforming sector of Chinese economy.

I. Introduction.

After China adopted in the late 1970s the policy of economic reforms, its annual output of major steel products was increasing at high pace, with a particularly pronounced growth during the 1990s. Between 1990 and 2001, the production of crude steel and pig iron approximately doubled, while the output of finished steel products increased by 2.5 times (Table 1). Eventually, China became the world's largest producer of crude steel in 1996 (Figure 1), surpassing for the first time the production in the United States and Japan. In subsequent years, China not only preserved its top position, but also increased its lead, achieving annual production of slightly above 150 metric tones in 2001, compared with 103 and 90 metric tons in Japan and the United States, respectively (International Iron and Steel Institute, 2003).

Please insert Table 1 about here.

Please insert Figure 1 about here.

Despite this rapid expansion of steel output, China's steel industry is still affected by various structural problems that stem from the dominant role of chronically underperforming state-owned enterprises (SOEs) in this industry. The major reason for the remaining strong presence of SOEs in the industry is that it is still perceived by the Chinese authorities as a 'pillar industry' that is crucial for China's economic development. In consequence, the government remains very cautious about allowing a comprehensive privatization of major steel enterprises. In consequence, the vast majority of major steelmakers in China still remain under control of either national or local authorities, even after many of them were converted into corporate entities in the late 1990s, and issued shares to domestic and foreign stock markets.

This chapter provides a broad overview of recent developments in China's iron and steel industry. Section 2 summarizes the recent expansion of China's iron and steel industry, with emphasis on changing product mix, technological modernization, and trade propensities of major steel products. The chapter points at persistent imbalances between supply and demand for products with low and high value-added content, in particularly, the failure of domestic producers to supply steel-products with high value-added content. Section 3 discusses major reform initiatives to modernize the industry, including (a) the recent corporatization experiment when major SOEs were converted into corporate entities, and (b) efforts to create internationally competitive steel conglomerates that are centered around the largest four steel producers in China (Anshan, Baoshan, Shougang, and Wuhan), which are commonly referred as the 'big-4' group. Section 4 evaluates the impact of various restructuring policies in this industry, and summarizes major studies that estimated the inefficiency of major steel enterprises in China. These estimates of enterprise efficiency are complimentary to single factor productivity estimates, reported in Chapter 4 of this book. Section 5 concludes the chapter with major policy implications of reported findings.

2. Major features of China's steel industry

2.1. Recent trends in steel output and employment.

Basic indicators for China's iron and steel industry during 1990-2001 are summarized in Table 2. Gross output grew from 30 billion dollars in 1990-1992 to 69 billion dollars in 2001. The growth mirrors the previously discussed growth of steel output in terms of metric tons (Table 1). The growth was interrupted only once, when steel output declined in 1993-1994, falling from 62.37 to 43.77 billion US dollars (principally due to 50 percent depreciation of the yuan in 1994).

Please insert Table 2 about here.

The real output in terms of domestic currency was expanding rapidly between 1990-1992 and 2001, from 143 to 420 billion yuan (measured in 1990 prices). There was only a single episode of output decline, which occurred in 1995, but at 1.8 percent, it pales in comparison with the average annual 11.8 percent growth during the whole period of 1990-2001. The share of steel industry's nominal value added in total gross domestic product (GDP) was fluctuating close to 2.0 percent in 1990-1996, but then declined to 1.2 percent in 1997-1999, with only a slight recovery in 2000-2001.

While output of steel industry was generally expanding during the 1990s, industry's employment was moving in the opposite direction. In the early 1990s, employment reached its peak of around 3.2 million, and then dropped to 2.9 million in 1998 and 2.5 million in 2000. The declining trend is likely to continue, reflecting the official policy to close a large number of inefficient small steel companies[1], with reductions of excessive employment in the remaining enterprises. One noteworthy feature of Chinese steelmakers is that they typically employ a much larger number of workers compared with steel enterprises abroad. For example, currently the largest steel maker in the world – Posco from South Korea – employs about 20,000 employees. On the other hand, the average employment in the 'Big-4' steel makers was 143,000 in 1990, and still exceeded 100,000 in 2000 (Movshuk, 2004). In consequence, there is a very large gap in average labor productivity between China's large firms and major American, Japanese and Korean steel makers, as documented in Chapter 8 of this book.

The implementation of downsizing policy in China's iron and steel industry is greatly complicated by the dominant role of SOEs in the industry. It is still common

[1] For example, the government announced in April 2000 its plans to close 103 small steel companies,

in China that the employment in a SOE is connected to various welfare benefits (such as housing and pensions), and it is very difficult to transfer these benefits to a different enterprise. While the welfare system was functioning well in the socialist economic system, with SOEs having ‘cradle to grave’ function for Chinese workers, the system no longer works well for downsized enterprises. In fact, it creates the worst-case scenario for workers when the loss of employment is often accompanied by losing one’s housing and accumulated pension benefits. The Chinese authorities are well aware about these risks of social instability due to further reductions in SOE employment. As a result, the government has clearly preferred to avoid any abrupt SOE downsizing, so that it is very improbable that the significant over-stuffing of many China’s steelmakers will be solved soon. Another major obstacle to more radical downsizing policy in Chinese SOEs is the underdevelopment of social security system outside of SOEs, in particular, the lack of sufficient resources to help unemployed workers in finding new jobs. As a result, even though the Chinese authorities are undoubtedly well aware about the substantial excess of labor force in steel industry, their actions to reduce the surplus are seriously limited by concerns that such policy can result in highly undesirable social instability.

Finally, another constraint to comprehensive labor layoffs is that steel enterprises often account for the lion’s share of local employment, and are the primary source of tax revenues for local governments. Brizendine and Oliver (2001) illustrate this constrain by Handan Steel, which is located in the city of Handan in Hebei Province. By various estimates, in the late 1990s unemployment rate in the city of Handan ranged from 30 to 70 percent. As for Handan Steel, it is a major employee in the city, and is also considered as a China's efficient steel producer. Yet its

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with a combined workforce of 129,000 (Conachi, 2000).

productivity was very low by international standards, just 103.5 tons per employee per year in 1998. In the same year, Handan Steel employed 28,176 people. Had the company raised its productivity to 200 tons per employee per year (which is still low by international standards, just a half of steel productivity in Brazil in the late 1990s), the company would have had to lay off 13,595 people in a city that already had 30-70 percent unemployment. In such a situation, it is clear that local government would actively oppose to drastic reductions in SOE's employment, let alone the outright liquidation of under-performing enterprises. In sum, even though the further reductions in the employment in steel industry are unavoidable, they will most likely proceed in a piecemeal, rather than abrupt, fashion.

When interpreting employment figures in Table 2, it is important to keep in mind that the official employment data include not only workers that are directly engaged in steel production, but also ones that are working in the extensive service sector of steel-making enterprises (such as hospitals, schools, research and development laboratories, construction, etc.). Available evidence about the magnitude of this overstatement is scarce, but Feng (1994, p. 222) reports that only 23 percent of employees in the Wuhan Iron and Steel Corporation were directly engaged in steel production in 1992. Similarly, out of 172 thousand employees of Anshan Steel, only 50 thousands were directly involved in steel production (Conachy, 2000).

This substantial over-reporting of employed workers should be kept in mind when evaluating the labor productivity of China's steel output. As reported in Table 2, value added per employee (in current US$) greatly increased from $2,367 to $4,329. After a slight decline in 1999, the productivity rose further to $6,237. At this level, the productivity was much lower than the comparable figures for not only Japan, but also Korea and Taiwan, reported in Chapter 4 and 5 of this book.

The low productivity of steel production was mirrored by relatively low level of labor compensation. In terms of current US$ per employee, it roughly doubled during the 1990s, from $651 in 1990-1992 to $1168 in 1998, and then reached $1401 in 2000. While this level of labor compensation was very low compared with other major steel producers in Asia, in terms of domestic currency, workers in this industry were receiving relatively high wages. For example, in 2000 the average wage level in steel industry was 11,597 thousands yuan, while for the total industry and for the total manufacturing the corresponding figures were 10,870 and 9,774 thousands yuan, respectively (National Bureau of Statistics, various years).

Among three major components of value added reported in Table 2, shares of wages and other operating surplus were relatively stable, moving in 22-31 and 69-78 percent range, respectively. In a marked contrast, the share of profits fluctuated considerably. It dropped from 16-20 percent in 1990-1996 to as low as just 1 percent in 1997-1998, though recovered somehow in later years. The precipitous decline in profits reflects the adverse effects of restrains on bank lending in the industry during the second half of the 1990s, to limit undesirable consequences of the investment spree in the early 1990s that greatly expanded productive capacity, but simultaneously resulted in large amounts of steel inventories.

2.2. Recent trends in steel exports and imports.

Historically, China was a net exporter of steel output. As reported in Tables 3a and 3b, its exports of steel grew from 2 billion US$ in early 1990s to 5 billion US$ in 2000, which was dwarfed by corresponding figured for imports, 4 billion US$ and 10 US$, respectively. A major reason for the negative trade balance is that the technological level of production in most China's steel makers is very low, resulting in insufficient domestic production of steel with high value-added content (such as hot-rolled and cold-rolled steel, galvanized sheet, stainless steel, tinplate, etc). At the same time China faces in increased international competition for its exports of steel with relatively low value added contents (such as rails, bars, rods, pipes, tubes, sections and plate). The disequilibrium is evident after examining 3-digit sub-categories of steel trade (classified by Standard International Trade Classification (SITC), Rev.2 as SITC 67). Most of China's steel exports are concentrated in SITC 671, 672, 673 and 678, which represent steel products with low value added content. On the other hand, China experienced a large trade deficit in high value added category SITC 674 (universals, plates, and sheets). In the early 1990s, the deficit was less than 2 billion US$, but then soared to almost 5 billion US$ in 1997-1998, and to more than 7 billion US$ in 2000-2001.

Insert Tables 3a and 3b about here

In the geographical distribution of China's steel exports, Asian markets were the dominant destination, accounting for more than 80 percent of total steel exports in 1990-1997. In recent years, however, the share of Asia declined somehow, but remained close to about two thirds of total exports. Japan and Korea were two largest national destinations of Chinese steel exports in 1990-1997. However, they were overshadowed by the United States in 1998-2001, with Chinese exports of about 0.7 billion US$, compared with 0.6 billion US$ Chinese exports to Japan and Korea. It is also noteworthy that most of the increased exports to the United States was accounted by a surge in SITC 674, a category of steel with high value-added content.

Asian countries also dominated in the geographical distribution of Chinese imports of steel, accounting for about three quarters of total imports, with Japan being the largest exporter of steel to China. In the first half of the 1990s, the second steel importer to China was Europe, but it was surpassed by Taiwan in the late 1990s. Steel imports from the United States were relatively small, accounting for just 1-2 percent of total Chinese steel imports.

As for the structure of steel imports to China, imports from Japan, Korea, and Taiwan had mostly high value added content, with SITC category 674 accounting for more than 70 percent of these countries total steel imports to China. On the other hand, imports from Europe (including transitional economies of Eastern Europe) and the United States had much lower ratios of this category of steel. For Europe, the ratio of SITC 674 was between 40-50 percent in most years, while for the United States, it was as low as 20 percent on average, indicating rather low value added content of imports from the U.S.

In addition to persistent trade deficit in steel, the low export capacity is reflected in the low share of exports in total output of steel in China. Prior to the 1997-1998 Asian financial crises, the share was fluctuating in 5-7 percent range[2], then temporarily surged to 10-13 percent during the crises, before gradually returning to 6 percent in 2001. The low export capacity of steel producers reflects previously mentioned low technological level of steel production in China, coupled with persistent inefficiency in steel enterprises. The following sections will examine these structural problems in more detail.

2.3. Technology of steel production.

Despite the recent increase to the record levels of production capacity (Fig. 1), the technological level of most steel producers remains low compared with China's major rivals in the global market. The continuous-casting rate rose rapidly from just 3.5

[2] The ratio is calculated from export and output data in nominal US dollars, reported in Table 2.

percent in 1978 to 46.5 in 1995, and to 87.1 in 2001. As shown in Fig. 2, as lately as in 1992 the ratio in China was essentially equal to the level in Russia, but Russia lagged after China in subsequent years, and their gap became especially pronounced in the late 1990s. Despite this rapid growth, the continuous-casting rate in China is still much lower compared with not only Japan, but also Korea, where the rate has been essentially 100 percent during the last decade (Fig. 2). However, if China continues to increase the continuous-casting rate, it is likely to approach the 100 percent level in the near future.

Please insert Figure 2 about here.

Another indicator of relatively low technological level of steel production in China is the use of open-hearth furnaces for steel production. While this highly inefficient method of steel production has been essentially abandoned long time ago in major steel-producing countries, in the early 1990s almost 20 percent of China's steel output was still produced by open-hearth furnaces. However, the share was constantly declining during the 1990s, so that China practically abandoned the method as well in recent years (for instance, the share was just 1.2 percent in 2001). Once again, contrasting China's experience with Russia is noteworthy. Russia once again was lagging behind China in technological upgrading of steel production, so that in recent years it was still using open-hearth furnaces to produce slightly more than one quarter of steel output (Fig. 3).

Please insert Figure 3 about here.

2.4. Enterprise structure in iron and steel industry of China.

China's steel industry is characterized by high fragmentation of steel production, which goes back to the infamous Mao's policy to increase steel production by setting up numerous small-scale ‘backyard furnaces’. Even at present, the number of steel-making enterprises remains high in China, with most major steel enterprises established in the late 1950s, at the peak of Cultural Revolution. Moreover, most of them are still small-scale enterprises, producing no more than 0.5 million metric tones of crude steel a year (Table 4), with only four enterprises in the ‘big-4’ group producing more than 5 million tones of crude steel. This group noticeably dominates the industry, accounting for almost one quarter of industrial output value in constant prices (Table 5), and about the same share of nominal sales revenues. The dominance of these major enterprises was even more evident in their almost 40 percent share in fixed assets. On the other hand, their share in total employment was significantly lower, around 18 percent, indicating that the largest four enterprises were much more capital-intensive compared with other steel-making enterprises.

Please insert Table 4 about here.

These ‘big-4’ steelmakers differ greatly in their historical background. Anshan Steel and Shougang Steel are the oldest ones, tracing their origin to the late 1910s and early 1920s, respectively. In the 1950s, they were at the forefront of vast modernization efforts that were predominantly based on the Soviet technology and technological expertise, some of them still in operation even now. Even though Wuhan Steel was set up much later (in the late 1950s), it also received substantial technological assistance from the Soviet Union, but in the 1970s, however, Wuhan Steel started to rely on more advanced technology from Japan and West Germany (Sugimoto, 1993, p. 270). Finally, Baoshan Steel represents the complete re-orientation to modern Western technology, with most facilities being replicated after several mills of Nippon Steel in Japan (*ibid*, p. 282). Baoshan steel started its operation in 1985, and since then has been generally considered as China’s most advanced and efficient steel producer.

Please insert Table 5 about here.

The relatively recent start-up date of Baoshan accounts for significant differences in the composition of steel output among Baoshan and the rest of 'big-4' steel makers. Baoshan, on the one hand, mostly produces hot- and cold-rolled sheets. These high value-added products accounted for about 60 percent of total finished steel products of Baoshan in 2001 (Table 6). On the other hand, the corresponding shares for Anshan and Wuhan were only half of the Baoshan's level, while Shougang reported no production of sheet products at all. The latter three steel makers concentrated on producing low value-added products, with Anshan and Wuhan specializing mostly in medium plate and Shougang – in wire rod.

Please insert Table 6 about here.

3. Recent reform initiatives to revitalize iron and steel industry.

Beginning from 'profit contracts' in the early 1980s, iron and steel industry of China was subject to numerous restructuring initiatives (Steinfeld, 1998). Even though the industry has been dominated by chronically underperforming SOEs, the government was reluctant to privatize these enterprises, let alone to allow that foreign owners get a majority stake in any major steelmaker. In consequence, reform initiatives were limited to various transformations within steel-enterprises, preserving at the same time the dominance of state ownership in the industry.

The most recent reform initiative in steel industry was conversion of many large enterprises into corporate entities. The experiment was started in mid-1990s, when the government selected 100 SOEs for pilot corporatizations, including 11 steel firms (World Bank, 1997, p. 73). Most of these firms were mid-size steel producers, and the government avoided to include in the pilot experiment any 'big-4' steelmaker. The government was satisfied with the pilot corporatization, and allowed the corporatization experiment to spread to a much large number of other steel makers, so that by the year 2000, the industry carried out an ambiguous goal to corporatize 80 percent of large and medium SOEs[3].

China's steel industry was also at the forefront of creating publicly listed companies. In 1993, Maanshan Steel became the first publicly listed SOE in China, with many other steel makers listing subsequently their shares on domestic and foreign stock exchanges. Finally, the industry vigorously implemented a sweeping campaign of mergers and acquisitions around the 'big-4' steel enterprises. Baoshan has already formed the core of the Baosteel group (after merging with Shanghai Metallurgical and Meishan), while mergers around other 'big-4' enterprises are in preparation (Hogan, 1999; Woetzel, 2001). A major goal of this merger campaign was to increase the share of the 'big-4' in total steel output of China to 40 percent in 2000, and then to 50 percent by 2005. So far, the goal for 2000 has proved unrealistic (as indicated in Table 5). The share of 'big-4' in nominal valued actually dropped from 30.6 percent in 1996 to 23.7 percent in 2000 (Editorial Board, various years).

As noted above, iron and steel industry exemplifies perhaps the most distinctive feature of China's approach to SOE reforms – the steadfast opposition to privatization in strategic industries, so that the central or local authorities have usually preserved their ownership control even after steel-making enterprises became corporate entities. For example, many converted enterprises in the industry actually turned into wholly state-owned companies that, according to OECD, are essentially "SOEs in the guise of a modern corporation" (OECD, 2000, p. 18). Similarly, when

[3] However, in the 'big-4' group, only Baoshan was corporatized in 2000.

SOEs became publicly listed companies, only a small portion of shares was available to outsiders, while their majority stakes remained under control of the central and local authorities, as well as listed companies themselves (Lardy, 1998, p. 56). The extent of these restrictions on non-state interests is exemplified by Wuhan Steel and Handan Steel. By 2000, these enterprises became publicly listed corporations, and comprised 28 and 7 subsidiaries, respectively, but in each company just a single subsidiary was publicly listed (Movshuk, 2004, p. 138).

Given such strong qualms about privatizing SOEs in strategic industries, it is not surprising that the recent sweeping corporatization campaign in the late 1990s did not substantially affect the prevalence of SOEs and state-holding enterprises in iron and steel industry. As shown in Table 7, at the outset of the corporatization campaign, the state-controlled enterprises accounted for about 54 percent of the total value added in this industry, and the share declined only slightly in subsequent years[4]. Similarly, there was hardly any reduction during the 1990s in the corresponding share in fixed assets. Thus, though iron and steel industry experienced the widespread introduction of new corporate ownership forms, the vast majority of large and medium steel enterprises in the industry remains under the state control, in a conspicuous contrast to the rapidly shrinking share of state-controlled enterprises in other sectors of Chinese economy (Jefferson et al., 2003).

Please insert Table 7 about here.

4. Impact of reform initiatives on enterprise performance.

The impact of China's reforms on enterprise efficiency continues to be a hotly debated topic. A number of studies examined this issue with data for iron and steel industry of

[4] Note that in 1998-2000, the Chinese statistics used a different criteria for sample coverage for total industry.

China. Their results are briefly summarizes in this section.

Conventionally, enterprise efficiency can be estimated either by the stochastic frontier approach (SFA) or by the data envelopment analysis (DEA). Most studies that evaluated the efficiency of China's steel making enterprises applied the SFA. Initially, only cross-sectional data were examined, but in recent years, there appeared a few studies that used various panel datasets. Kalijaran, Cao (1993) and Wu (1996) used a single cross section of 97 and 87 Chinese steelmakers, respectively. Perhaps, because these studies used data for the same year (1988), they reached very similar conclusions that Chinese steelmakers achieved only about 60 percent of their potential output, or, to put it alternatively, were 60 percent efficient[5]. In a more recent study, Zhang and Zhang (2001) analyzed the 1995 census data for steel industry. The sample contained 421 company, and estimated efficiency was again very low, only 54.6 percent. The study also differentiated enterprises by ownership and size, and found that efficiency in SOEs was relatively low (52.4 percent). On the other hand, enterprises with foreign investment had the highest efficiency (62.9 percent), but due to the small share of these enterprises in the examined sample[6], their impact on the industry's performance was hardly discernible.

The first study that employed panel data techniques appears to be Wu (1995). He examined a panel of 61 steel making enterprises over 1984-1992, and attempted to evaluate various potential factors of different technological efficiency across enterprises. Four major factors were considered, including enterprise age, agglomeration effect[7], ownership[8], and size[9]. Similarly to earlier studies with cross-

[5] The SFA defines technical efficiency as the ratio of observed to potential output.
[6] In terms of value added, they accounted for just 1 percent of the sample's total.
[7] The variable accounted for the total number of enterprises in a given region, and the total value of output produced in the region.
[8] The variable distinguished between key and local enterprises, which fall under the jurisdiction of the central and local authorities, respectively.

sectional data, the study found substantial inefficiency in China's steel production in the 1980s. However, there was a positive trend in estimated efficiency, from 68.9 percent in 1984, to 75.8 percent in 1988, and to 82.1 percent in 1992. Among various explanatory variables for enterprise efficiency, only enterprise age and agglomeration effect turned out statistically significant, and both had positive effects on efficiency. The study also attempted to estimate potential benefits of shutting down the least efficient steelmakers, and concluded that if only one-quarter of these firms were closed in 1992 (with resources transferred to more efficient firms), China's steel output would have increased by about 7 percent (from 91 to 98 metric tones).

More recently, Movshuk (2004) examined a panel of 82 Chinese steelmakers. The study estimated enterprise efficiency during 1988-2000, so it was possible to evaluate effects of recent restructuring initiatives, including the corporatization experiment, and the merging campaign around the 'big-4' steelmakers.

Similarly to Wu (1995), the study found that technical efficiency was around 85 percent in the late 1980s. Subsequently, the estimated efficiency was stagnating until 1994. However, the efficiency declined to about 70 percent during 1994-1997, and experienced a temporal pick-up in 1997-1998 (coinciding with the acceleration of the corporatization experiment). In more recent years, the estimated efficiency changed little. To identify driving forces behind the deterioration in technical efficiency during 1994-1997 and its subsequent rebound during 1997-1998, the study differentiated between the 'big-4' and other steelmakers in the sample. During 1988-1993, estimated efficiency for these two groups of enterprises was clustered at quite high level, about 80-85 percent. Then the downward drop in efficiency during 1994-1997 turned out very similar between these groups of enterprises. By the end of the

[9] The impact of size was measured by two dummy variables, for medium and large enterprises.

1990s, the ‘big-4’ and other steelmakers have converged to essentially the same level of technical efficiency, slightly less than 80 percent. The study concluded that it was ironic that when China’s authorities were counting on the biggest steel-making SOEs in their efforts to improve enterprise efficiency, these enterprises apparently had no efficiency advantage over other steelmakers in the industry.

In addition, the study attempted to identify important variables that could explain the variation of technical efficiency across Chinese steelmakers. These variables included enterprise age, capital intensity, a time trend, and a set of time dummies to account for possible differences in efficiency between the ‘big-4’ steelmakers and other enterprises in the sample, as well as possible efficiency improvement during the widespread implementation of the corporatization experiment in 1997-2000. Among these variables, only two variables turned out statistically significant: time trend and the dummy variable for 1997-2000. The sign of these variables indicated worsening efficiency level over time, and a one-time pick-up in efficiency during 1997-2000.

While the above-mentioned studies made estimates of technical efficiency by the stochastic-frontier approach, Ma et al. (2002) examined the issue by an alternative method, the data-envelopment analysis (similarly to the analysis in Chapter 5 of this book). The study’s coverage of enterprises is similar to Movshuk (2004), with a panel dataset of 88 enterprises over 1989-1997. The study found that the mean technical efficiency was 59 percent in 1989, and remained very low (66 percent) even in 1997. The efficiency frontier was established by a small sub-group of enterprises. Six of them were on the efficiency frontier for the entire period. Though Baoshan was among these six enterprises, the rest of them were either small or medium-size steelmakers, in agreement with other studies that also did not find a definite efficiency edge of the 'big-4' steelmakers over the smaller ones.

In sum, these studies of the efficiency performance of Chinese steelmakers indicate high inefficiency in steel production not only in the late 1980s, but also in more recent years. Moreover, it appears that there are persistent inefficiencies across the vast majority of Chinese steelmakers, with only a few exceptions (such as Baoshan Steel, but not the other enterprises from the 'big-4' group).

Summary.

After the start of economic reforms, China's steel industry experiences a dramatic increase in steel output, so that China became in recent years the global leader of steel production in terms of metric tones. However, most of China's steel output has low value added content, resulting in large domestic demand for imports of steel with high value added content. The inability of China's steelmakers to satisfy the domestic demand for such steel products is due to the relatively low technological level of steel production in China, though in recent years the industry achieved significant progress in upgrading its technological facilities. Still, available estimates of efficiency of steel production reveal a large room for further improvements in efficiency, and point that recent restructuring initiatives have hardly resulted in a significant improvement in technological efficiency. One possible explanation for this lack of progress is the cautions attitude of the Chinese authorities towards privatizing this industry, so that the dominance of chronically underperforming SOEs in this industry remains unchallenged.

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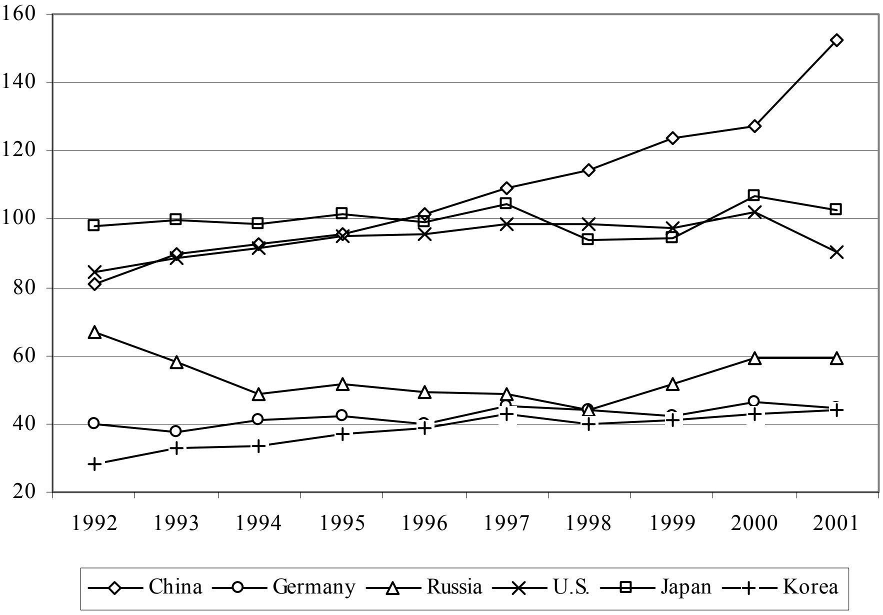
Table 1. Output of major steel products (metric tons).

	1980	1985	1990	1995	1999	2000	2001
Crude steel	37	47	66	95	124	129	152
Pig iron	38	44	62	105	125	131	156
Finished steel products	27	37	52	90	121	131	161

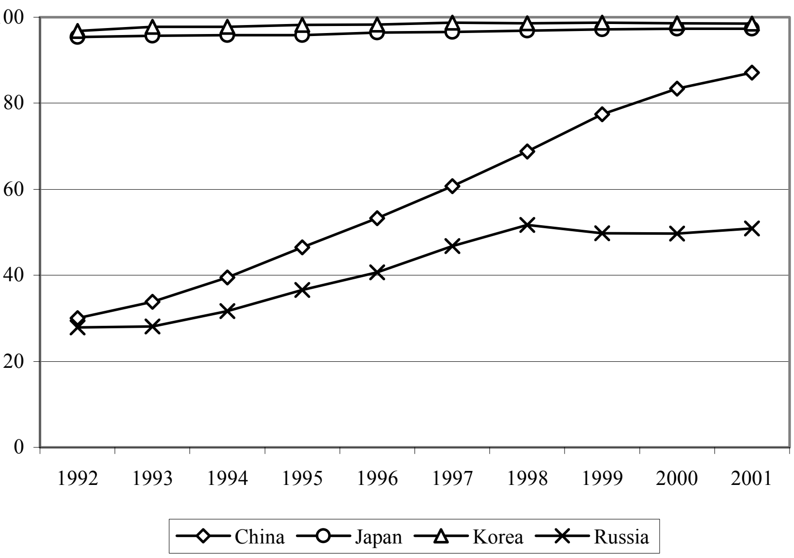
Source: Editorial Board (various years).

Fig. 1. Total production of crude steel by country (million metric tons)



Source: International Iron and Steel Institute (2003).

Fig. 2. The share of continuously-cast steel in total crude steel production (percent)



Source: International Iron and Steel Institute (2003).

Table 2: Basic Indicators for China's Steel Industry

Indicator	1990-1992	1993-1996	1997	1998	1999	2000	2001
Gross Output							
Billion current US$-firms-a	30.045	48.823	40.107	40.598	41.901	57.161	68.953
Billion current yuan-firms-a	157.409	369.847	332.491	336.148	346.940	473.290	570.731
Billion 1990 yuan-firms-a	142.869	186.917	204.023	223.009	242.440	346.671	419.671
Value Added							
Billion current US$-firms-a	7.633	14.597	10.688	10.932	11.414	15.692	18.487
Billion current Yuan-firms-a	40.025	109.783	88.604	90.517	94.510	129.929	153.015
- % of GDP	1.782	2.297	1.211	1.176	1.173	1.473	1.622
Billion 1990 Yuan-firms-a	na	na	na	na	na	na	na
- % of GDP	na	na	na	na	na	na	na
Employment							
Number	3.218	3.278	na	2.881	na	2.516	na
- % of total	0.492	0.498	na	0.408	na	0.349	na
Value Added/Employee, firms-a							
Current US$	2,367.241	4,328.704	na	3,795.176	na	6,237.095	na
Thousand current Yuan	12.401	32.508	na	31.424	na	51.643	na
Thousand 1990 Yuan	na	na	na	na	na	na	na
Compensation/Employee							
Current US$-firms-a	651.25	950.94	na	1,167.77	na	1,400.61	na
Thousand current Yuan	3,411.15	7,372.30	na	9,669.15	na	11,597.04	na
Shares of Value Added in Percent							
Wages & salaries	27.47	23.14	na	30.77	na	22.46	na
Other operating surplus	72.53	76.86	na	69.23	na	77.54	na
Profits	20.03	15.77	1.17	1.00	2.69	8.81	na
	0.050	0.066	0.128	0.099	0.081	0.093	0.060
Exports (value from Stats Canada, quantity from OECD)							
Billion current US$	1.51	3.20	5.14	4.00	3.40	5.32	4.15
- % of Gross Output	5.14	6.98	12.81	9.86	8.11	9.30	6.01
Quantity 1995=100	23.55	53.09	89.82	55.08	52.40	94.12	57.04
Implicit Price 1995=100	155.16	119.69	125.85	158.02	136.59	87.20	93.05
Imports (value from Stats Canada, quantity from OECD)							
Billion current US$	3.61	9.98	8.26	7.50	8.74	10.70	10.84
- % of Gross Output	11.83	20.43	20.60	18.49	20.86	18.72	15.72
Quantity 1995=100	21.15	160.68	92.74	89.03	116.49	143.68	184.03
Implicit Price 1995=100	na	87.33	136.91	127.96	110.35	80.28	52.64

Table 3a: The Value of China's Steel Exports by Commodity and Destination (US$ millions)

Indicator	1990-1992	1993-1996	1997	1998	1999	2000	2001
All Steel (SITC 67)	1,514	3,200	5,137	4,004	3,398	5,316	4,147
Asia	1,334	2,572	4,159	2,460	2,250	3,640	2,688
Japan	341	648	819	592	479	763	558
Korea	143	697	1,455	431	517	861	517
Taiwan	75	207	329	405	365	572	306
Europe	62	272	372	499	401	566	500
North America	90	279	465	689	574	935	741
U.S.A.	85	246	388	589	520	772	618
	0.88	0.80	0.81	0.61	0.66	0.68	0.65
Pig iron, sponge iron, etc. (SITC 671)	405	1,082	1,592	1,076	842	1,244	858
Asia	350	871	1,316	746	651	1,005	661
Japan	203	403	382	240	214	390	290
Korea	43	275	680	323	243	377	194
Taiwan	12	42	85	90	87	112	82
Europe	33	146	170	166	119	128	112
North America	20	54	88	132	50	80	58
U.S.A.	20	43	53	85	43	58	36
Ingots, primary forms, etc. (SITC 672)	165	503	1,003	576	455	1,038	545
Asia	165	498	1,002	570	440	1,004	534
Japan	6	35	54	50	28	49	19
Korea	25	173	341	24	47	178	68
Taiwan	37	123	155	226	209	378	159
Europe	0	1	0	4	2	1	3
North America	0	3	1	3	13	31	7
U.S.A.	0	3	1	3	13	30	7
Bars, rods, angles, shapes (SITC 673)	391	261	325	201	181	358	365
Asia	386	246	302	169	143	249	287
Japan	21	9	5	2	1	3	4
Korea	38	26	13	2	10	43	47
Taiwan	14	7	14	9	6	6	3
Europe	0	3	4	5	5	2	5
North America	1	9	13	16	17	93	60
U.S.A.	1	8	13	14	16	84	35
Universals, plates, sheets (SITC 674)	174	599	890	641	571	1,076	570
Asia	172	476	739	328	389	588	351
Japan	69	92	164	103	77	128	33
Korea	26	161	325	34	155	179	112
Taiwan	5	2	2	6	3	7	2
Europe	0	47	51	116	37	176	88
North America	0	66	83	162	120	291	100
U.S.A.	0	59	75	147	111	216	93
Tubes, pipes, fittings (SITC 678)	214	358	655	814	632	826	995
Asia	137	231	397	318	310	437	496
Japan	22	35	56	55	46	69	77
Korea	5	23	38	23	27	33	37
Taiwan	3	18	47	50	36	43	39
Europe	16	31	46	76	78	75	93
North America	49	61	140	181	172	249	303
U.S.A.	46	53	122	166	158	217	261

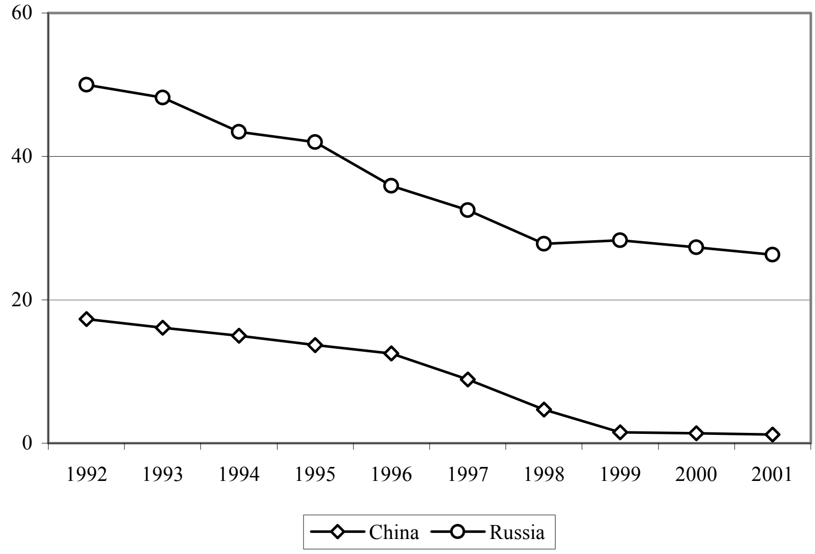
Source: Statistics Canada (2002).

Table 3b: The Value of China's Steel Imports by Commodity and Source (US$ millions)

Indicator	1990-1992	1993-1996	1997	1998	1999	2000	2001
	0.585	0.688	0.738	0.635	0.744	0.808	0.728
All Steel (SITC 67)	3,608	9,978	8,264	7,505	8,740	10,699	10,839
Asia	2,577	6,293	6,350	6,083	6,590	8,295	8,262
Japan	1,388	2,425	1,955	1,621	1,898	2,502	2,500
Korea	318	875	1,003	1,124	1,334	1,648	1,671
Taiwan	51	415	888	1,059	1,467	2,004	2,244
Europe	454	1,202	451	400	376	498	774
North America	90	162	86	87	87	111	123
U.S.A.	57	101	62	78	82	97	112
Pig iron, sponge iron, etc. (SITC 671)	82	70	35	34	71	112	181
Asia	8	41	23	18	28	33	65
Japan	2	6	8	8	19	22	35
Korea	0	2	2	2	2	2	3
Taiwan	0	2	1	2	2	3	5
Europe	1	2	1	1	3	5	6
North America	0	1	8	7	8	17	15
U.S.A.	0	1	8	7	8	12	12
Ingots, primary forms, etc. (SITC 672)	204	534	62	120	600	943	984
Asia	61	113	23	45	88	210	359
Japan	7	9	5	12	38	40	117
Korea	23	14	2	15	11	9	75
Taiwan	2	7	8	10	27	66	33
Europe	10	58	10	10	6	52	27
North America	1	7	1	9	1	18	31
U.S.A.	1	6	1	9	1	17	29
Bars, rods, angles, shapes (SITC 673)	405	2,684	1,230	1,009	708	557	583
Asia	246	1,066	474	556	462	458	490
Japan	70	247	168	170	136	123	136
Korea	83	175	65	132	72	65	69
Taiwan	4	53	85	107	136	140	162
Europe	77	489	74	54	49	52	65
North America	2	19	15	4	3	5	5
U.S.A.	2	17	15	4	3	5	4
Universals, plates, sheets (SITC 674)	1,982	5,389	5,880	5,233	6,429	8,101	7,944
Asia	1,667	4,230	5,062	4,680	5,336	6,849	6,547
Japan	812	1,670	1,444	1,030	1,412	2,023	1,819
Korea	200	619	791	897	1,158	1,486	1,430
Taiwan	33	243	649	780	1,125	1,566	1,844
Europe	173	369	187	143	189	265	465
North America	14	56	19	15	31	34	28
U.S.A.	5	26	7	14	28	29	25
Tubes, pipes, fittings (SITC 678)	860	990	787	851	612	604	795
Asia	543	656	558	573	418	435	524
Japan	484	442	292	364	240	230	342
Korea	4	35	105	31	32	22	24
Taiwan	7	68	84	94	98	126	109
Europe	179	207	151	177	116	102	187
North America	69	58	32	45	32	25	31
U.S.A.	47	43	20	37	31	22	30

Source: Statistics Canada (2002).

Fig. 3. The production of crude steel in open hearth furnaces (percent)



Source: International Iron and Steel Institute (2003).

Table 4. Enterprise structure in China's iron and steel industry (1980-2001)

	1980	1985	1990	1995	1999	2000	2001
Total number of enterprises	1332	1318	1589	1639	1042	2997	3176
out of which: enterprises with annual steel output							
greater than 5 million Mt	0	0	0	4	4	4	4
between 1 and 4.99 million Mt	12	12	16	21	30	37	47
between 0.5 and 0.99 million Mt	2	6	12	17	18	13	11
less than 0.5 million Mt	1318	1300	1561	1597	990	2943	3114

Note: Mt denotes metric tons.
Source: Editorial Board (various years).

Table 5. The share of 'big-4' enterprises in total iron and steel industry

	Industrial output value[a]	Sales revenue	Industrial value added	Fixed assets	Employees
1991-1994	0.245	0.245	0.301	0.399	0.186
1995-1997	0.244	0.272	0.288	0.364	0.179
1998-2000	0.235	0.252	0.265	0.340	0.183
Average (1988-2000)	0.239	0.248	0.287	0.378	0.182

[a]At 1990 constant prices
Source: Editorial Board (various years).

Table 6. The share of major products in total output of 'big-4' steel makers in 2001.

	Anshan	Baoshan	Shougang	Wuhan
Ordinary small section	0.044	0.000	0.390	0.052
Wire rod	0.116	0.071	0.404	0.117
Medium plate	0.339	0.191	0.078	0.328
Sheets	0.289	0.601	0.000	0.295
Other	0.212	0.137	0.129	0.209

Source: *Source*: Editorial Board (various years).

Table 7. Share of SOEs and state-holding enterprises in gross output, value added and fixed assets of iron and steel industry.

	Value added	Fixed capital
1995	0.538	0.637
1996	0.485	0.642
1997	0.463	0.616
1998	0.570	0.723
1999	0.563	0.718
2000	0.543	0.712

Source: National Bureau of Statistics (various years).
Note: until 1997, shares refer to enterprises with independent accounting system at township and higher levels, while in 1998-2000, shares refer to all state-owned industrial enterprises and enterprises above designated size (namely, with annual sales of over 5 million yuan).