The Shenyang Smelter

A Case Study of Problems and Reforms in China's Nonferrous Metals Industry

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William A. Byrd is an economist in the China Division of the World Bank's East Asia and Pacific Regional Office.

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Abstract

This case study focusses on the serious problems faced by a large Chinese nonferrous metals smelter and how the plant responded to them. The most important problems were an increasingly disadvantageous location (in the physical/technical sphere) and a "multi-headed leadership system" (involving different supervisory agencies in the management sphere). Measures taken by the enterprise had only mixed success in dealing with severe constraints and a deteriorating environment. The same is true of the administrative restructuring and centralization of control in China's nonferrous metals industry in 1983. Though this had some beneficial effects, particularly with respect to the Shenyang Smelter, organizational reforms alone cannot provide a fundamental solution to the problems of China's nonferrous metals industry. Other tentative conclusions of the study may be applicable to Chinese industry as a whole: (1) Reform implementation is difficult and reforms tend to be more ineffective in a chronic shortage situation. (2) In a chronic shortage situation there are strong incentives for backward integration, and under these conditions administrative demarcation of enterprises, goods, and activities can become a source of inefficiency. (3) The choice between importing and domestic production should be based on a careful economic evaluation, but in China it is distorted by a one-sided desire for self-sufficiency (now being modified), biased incentives to export, administrative fragmentation, and other factors. (4) An indiscriminate policy of technical renovation in existing enterprises is inappropriate if the enterprise receiving the new investment and technology is not in a fundamentally sound position with respect to location, scale, material supplies, energy, etc. (5) There is the danger that administrative reorganization just degenerates into reshuffling, leaving the most important relationship, that between the enterprise and its supervisory agency, largely unaffected.

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SUMMARY

1. This is a study of the Shenyang Smelter, a large Chinese nonferrous metals plant which is one of 20 Chinese state-owned industrial enterprises surveyed in a collaborative research project between the Institute of Economics of the Chinese Academy of Social Sciences and the World Bank. The paper is based on extensive interviews with factory managment and related government authorities, as well as quantitative information provided by the enterprise (see Statistical Appendix) and Chinese press and journal articles. Available information on China's nonferrous metals industry as a whole and some information on the world nonferrous metals industry also has been utilized, both to provide background and to draw wider implications of the Shenyang Smelter's experience.

2. The focus of this case study is the serious difficulties and worsening environment faced by the Shenyang Smelter and measures taken by the enterprise to deal with the situation. The severity of the problems confronting the plant dominated the impact of reforms, especially since the smelter appears to have been no more advanced than average in most aspects of enterprise-level reforms (among larger state-owned industrial enterprises). The plant adapted to the situation and did the best it could, concentrating on survival from day to day, marginal improvements, and avoiding deterioration. Its response to problems achieved only mixed success. The same is true of the administrative restructuring and recentralization of control in the nonferrous metals industry, which was a systemwide response to the problems of the whole industry. This did have some important benefits for the Shenyang Smelter, however.

3. Chapter I of this study provides elementary background information on main developments and trends in the world nonferrous metals industry. It also contains an introduction to China's nonferrous metals industry, based on available published information. The chapter ends with a brief review of the history of the Shenyang Smelter. One of the most important historical developments affecting the plant was the emergence of a "multi-headed leadership system" (with respect to government agencies supervising the enterprise) as a result of a massive but uneven territorial/administrative decentralization during the Cultural Revolution period. Another key point is that by the mid-1970s the smelter had reached a "plateau" in its primary production activities, which made subsequent improvements in efficiency and financial indicators much harder to achieve. Finally, the plant developed on one site in increasingly urbanized surroundings, which made expansion in the immediate area virtually impossible after a certain point and moreover meant that its heavy pollution had extremely high social costs.

4. Chapter II surveys the main problems that the Shenyang Smelter faced in the late 1970s and early 1980s, with emphasis on the interrelations among different problems and the question as to why most of them increased in severity at about the same time. The fundamental physical/technical constraint on the smelter was its increasingly disadvantageous location. Though this prevented any large-scale expansion at the existing site and hence had a strong impact on enterprise decisionmaking, the plant does not itself pay for most of the social costs of its poor location. The pollution problem

is directly related to the Shenyang Smelter's location in a crowded urban environment. Location also aggravates problems with the supply of raw materials and energy. The multi-headed leadership system was the critical organizational problem faced by the Shenyang Smeltery in the 1970s and early 1980s, which was manifested in nearly all spheres of activity. It resulted in sometimes serious inconsistencies between output and profit targets and input allocations given to the smelter by different authorities. The plant constantly had to bypass the organization immediately in charge of it, which did not have sufficient authority or expertise to help out in many areas but at the same time made many demands on the enterprise. The smelter also faced a confused supply system with numerous gaps and involvement by different organizations at three levels of government (central, provincial, and municipal) in allocating key material inputs and energy. The shortage of investment funds was probably aggravated by the multi-headed leadership system as well. Because many of its workers were older and had numerous children, the smelter shouldered a great burden in trying to find jobs for them in the enterprise or in subordinate collective companies it set up. This last problem was quite widespread in China in the late 1970s and early 1980s, and the Shenyang Smelter's response to it was similar to that of other enterprises in Northeast China.

5. Chapter III analyzes the enterprise's response to the difficult situation. In some areas relatively narrow technical measures were taken to deal with particular problems. Short-term production management techniques minimized inventories resulting from lack of control over the timing of arrivals of raw materials and ensured that shortfalls in electricity supply would only affect production of the smelter's most electricity-intensive product. Comprehensive utilization of byproducts of the smelting process and pollution control measures also appear to have been rather successful, though the potential for further improvements in both of these areas may diminish in the future. The same is true of attempts to conserve energy, which are hindered by the shortage of investment funds and especially by the relatively low financial returns to energy conservation projects (due to the low price of energy allocated within the state plan). The enterprise has been successful in maintaining very high quality standards, which may have been uneconomic in view of users' needs. On the other hand, the Shenyang Smelter was to a considerable degree unsuccessful in trying to obtain more investment funds and extra financial resources for workers' benefits (though workers were largely "protected" from the sharp decline in profits and profitability in 1983). The plant also was unsuccessful in its efforts to engage in the lucrative production of alloys and was still required to deliver pure metals to procurement agencies, at least at the time that the last interviews were conducted (in late 1984). Finally, there was no effective response to the problem of location, which was beyond the capability of the smelter to deal with on its own anyway.

6. Chapter IV looks at the systemwide response of administrative reorganization and recentralization in the early 1980s, designed to solve or at least ameliorate the problems of China's nonferrous metals industry as a whole. Like the previous decentralization of 1970-1971, the recentralization was somewhat uneven across different spheres of activity. The newly-created China Nonferrous Metals Industry General Corporation was in principle given

the authority to coordinate the overall development of the nonferrous metals industry, but its ability to do so in practice was greatly weakened by certain provisions of the recentralization measures. There also appears to have been a considerable amount of administrative reshuffling, as opposed to real changes in the "rules of the game" or in the relationship between enterprises and supervisory agencies. From the viewpoint of the Shenyang Smelter, organizational reforms were unambiguously helpful in eliminating the worst "head" in the multi-headed leadership system. But the changes appear not to have had a significant effect on the fundamental problems faced by the enterprise.

7. The last chapter attempts to distill some more general observations and conclusions from the Shenyang Smelter's experience and that of China's nonferrous metals industry, which may be applicable to Chinese industry as a whole. The most important of these include the following: (1) Reform implementation is much more difficult in a chronic shortage situation. Moreover, even if they are actually implemented, reforms tend to be ineffective in improving efficiency and increasing customer orientation on the part of producers. (2) In a chronic shortage situation there are strong incentives for backward integration. Under these conditions administrative demarcation of enterprises, goods, and activities may be resorted to and is likely to be a source of inefficiency. (3) The choice between importing and domestic production should be subject to careful economic evaluation (using appropriate shadow prices if necessary). However, in China this choice is distorted not only by the price structure but also by a one-sided desire for self-sufficiency (apparently now being modified), biased incentives to export, administrative fragmentation, and other factors. (4) An indiscriminate policy of promoting technical renovation in existing enterprises is appropriate only if the enterprise receiving the new investment and technology is in a fundamentally sound position with regard to location, scale, material supplies, energy, etc. Otherwise it is often better to shut down the existing facility and build a completely new one under more appropriate conditions. (5) Administrative reorganizations can very easily degenerate into mere reshuffling, which may not result in any major improvement and may leave the most important relationship, that between the enterprise and its supervisory agency, largely unaffected.

I. INTRODUCTION

1.01 Reforms since 1978 have had a strong impact on the incentives and behavior of many Chinese state-owned industrial enterprises.[1/] For various reasons the Shenyang Smelter, which is the subject of this case study, was much less affected. In the first place, it is a producer of homogeneous products (pure copper, lead, and zinc, sulphuric acid, and various metal by-products), which are strategic materials chronically in short supply and require raw materials which are also in short supply as well as large amounts of energy. Reforms expanding the role of the market mechanism in resource allocation tend to be more difficult to implement in this kind of situation than in the case of high-priced goods in excess supply.[2/] The Shenyang Smelter also appears not to have been especially advanced in financial reforms and profit retention schemes (see pp. 50,52), and the same is true to a lesser extent of wage reforms and bonus schemes.

1.02 But perhaps the most important reason why reforms had only a limited impact on the Shenyang Smelter was the increasingly severe, often interrelated, and mutually reinforcing problems it faced in the late 1970s and early 1980s. These generated a highly restrictive environment which severely hindered the smelter's freedom of action and dominated its attention, making many enterprise-level reforms largely irrelevant from its point of view. Hence the main theme of this paper concerns these problems: how they arose and how the enterprise responded to them. Of particular interest is the nationwide reorganization and recentralization of administrative control in the nonferrous metals industry that occurred in 1983 and had a considerable impact on the Shenyang Smelter. The role of the smelter and its management appears to have been relatively passive, particularly compared with other enterprises that have been at the forefront of reform or in a better position.[3/] Thus the essence of the story is what happened to the enterprise, not how it manipulated its environment. It adapted and did the best it could, with the focus on survival from day to day, marginal improvements, and avoiding deterioration.

1/ An outstanding example is the Chongqing Clock and Watch Company, discussed in Byrd and Tidrick (1984). Other enterprises which introduced strong profit incentive systems and/or were subjected to the pressures of a weak market on the output side also in many cases appear to have made considerable progress in implementing reforms and improving efficiency.

2/ The smelter was at least in one respect better off in that it made considerable profits and the main reason for shortage of its output was raw material supply constraints (complemented by controls on imports) rather than artificially low prices. Of course the shortage of ore and inadequate investment in mining of nonferrous metals reflects low prices for ores.

3/ In addition to the Chongqing Clock and Watch Company, some examples of particularly "entrepreneurial" Chinese state-owned industrial enterprises are the Mindong Electrical Machinery Company and the No. 2 Automobile Plant, which may be the subject of later studies.

1.03 This chapter will continue with a brief discussion of the role of nonferrous metals in economic development and the main trends in world nonferrous metals industry and trade. Then the development of China's nonferrous metals industry will be described and assessed. In both of these sections, the focus will be on the so-called "heavy" nonferrous metals (lead, copper, zinc, and tin), since these include the Shenyang Smelter's main products. The chapter will end with a brief history of the Shenyang Smelter. Chapter II will look at the main problems faced by the smelter in the late 1970s and early 1980s, trying to ascertain their sources and interrelationships and why many of them came to a head at around the same time. Chapter III will analyze the main responses of the Shenyang Smelter to these problems, evaluating their success individually. The systemwide response of reorganization and recentralization of the industry, including the establishment of the China Nonferrous Metals Industry General Corporation in 1983, deserves separate treatment and is the subject of Chapter IV. Finally, Chapter V will distill some more general observations and conclusions based on the Shenyang Smelter's experience.

Nonferrous Metals in Economic Development 4/

1.04 The uses of nonferrous metals expand greatly during economic development; demand and consumption tend to rise rapidly in the process of industrialization. Total per capita consumption of nonferrous metals is highly correlated with a country's level of development (as indicated by GNP per capita), though it is also related to the degree of industrialization, subsectoral structure of industry, infrastructure, substitution possibilities, and national endowment of mineral resources. The elasticity of nonferrous metals consumption with respect to growth of average per-capita national income is typically very high at low income levels and during the early stages of industrialization. For nearly all metals and countries in this situation it has been well above unity. At higher levels of per-capita income, consumption elasticities tend to fall below one, though the pattern varies greatly for different countries and metals. Aluminum, for example, has a high consumption elasticity at all income levels, which shows up in both cross-section and time-series analysis.

1.05 Historically, consumption of nonferrous metals has grown rapidly from the start of the industrial revolution in England, stimulated by scientific discoveries of new metals and new uses for metals. As can be seen from Table 1.1, world consumption of nonferrous metals has grown steadily except in

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4/ The discussion in this and the following section is based mainly on Lotte Muller-Ohlsen (1981, particularly pp. 18 and 82-92). Another book on the world nonferrous metals industry is United Nations, (1972). Useful sources of quantitative information on nonferrous metals production, trade, and prices include Schmitz (1979), and Metal Statistics. Still another handy reference is Robbins, (1982).

Table 1.1: WORLD CONSUMPTION OF MAJOR NONFERROUS METALS, 1890-1983

	Aluminum	Copper /a	Lead /b	Zinc	Tin	Nickel	Total
1890	-	289	567	347	56	-	1,258
1900	7	513	871	475	82	-	1,948
1910	44	922	1,123	825	119	-	3,033
1920	132	929	974	689	127	-	2,850
1930	206	1,639	1,523	1,233	167	-	4,762
1940	823	2,711	1,653	1,741	167	-	7,094
1950	1,584	3,009	1,868	2,075	170	158	8,888
1960	4,177	4,756	2,617	3,082	201	293	15,125
1970	10,028	7,291	3,914	5,042	226	577	27,077
1979	16,017	9,883	5,481	6,332	234	777	38,725
1983	15,466	9,116	5,285	6,355	206	691	37,119

/a Figures for 1890-1920 are for unrefined copper; those from 1930 onwards are for refined copper.

/b Figures for 1890-1950 are for pig lead; those from 1960 onwards are for refined lead.

Sources: Muller-Ohlsen (1981, p. 92); Metallgesellschaft, AG (1984, pp. 4-5). Some figures for earlier years are based on three-year averages.

times of major wars.[5/] World consumption of copper increased by 33-fold between 1890 and 1970, reaching 7.2 million tons in the latter year. Growth of zinc and lead consumption was somewhat slower, 17-fold and 9-fold, respectively.

1.06 The structure of consumption of nonferrous metals has undergone important changes, driven by discovery of new metals, of new uses for metals, and substitution among different metals in consumption. Substitution of other materials for certain nonferrous metals (e.g. plastic for copper pipes) has also been an important factor in recent years. The rapid growth in consumption of aluminum and other "light" nonferrous metals has been especially noteworthy. Among the "heavy" nonferrous metals, the share of copper has held its own (meaning its share in heavy nonferrous metals consumption rose considerably), while those of lead and to a lesser extent zinc have fallen.

Production and International Trade of Nonferrous Metals

1.07 The growth of demand for nonferrous metals has stimulated increases in production, worldwide exploration and exploitation of previously untapped mineral resources, and improvements in the technology of mining and smelting. The nonferrous metals industry has tended increasingly to take advantages of economies of scale with larger production units. Advances in technology have permitted ores with very low metal content to be mined. For example, the lower limit for exploitation of copper ores is below 0.5% metal content.[6/] Another area where great advances have been made is the recovery of byproducts and impurities generated in the smelting process. Ancillary production of sulfuric acid by copper, lead, zinc, and nickel smelters has long been common practice in the world nonferrous metals industry. Roasting of sulfide ores generates metal oxides and sulfur dioxide, which would be a harmful pollutant if not converted into sulfuric acid. Another key feature is the great and growing reliance on secondary recovery of nonferrous metals from scrap metal products. In 1979, for example, secondary recovery accounted for close to 40% of total world production of copper, 36% of lead, and 21% of zinc.[7/]

1.08 Some interesting trends in the location of the different stages of production (mining, ore preparation, metal extraction and refining, and metal fabrication) for the main nonferrous metals are evident. In the early stages

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5/ The table presents estimates only starting in the late 19th century, but growth from 1800-1890 was also rather rapid, although starting from a tiny base. Average annual growth of consumption in 1800-1890 was 3.7%, in 1890-1979 3.9%, due largely to the spectacular growth of aluminum consumption (Muller-Ohlsen, 1981, p. 92).

6/ Muller-Ohlsen (1981, p.21).

7/ The figure for lead is biased downward because it excludes some scrap recycling that is included in refinery production. See Muller-Ohlsen (1981, Table 37, p. 170).

of industrialization, mining and smelting tended to be located close together (in the industrializing countries where demand was increasing sharply) and were usually integrated under single-company management. As local sources of raw materials dwindled, ore mining tended to move overseas to less developed countries and thereby became separated from smelting. Overseas mines were generally autonomous, supplying ores to smelters in market transactions. Many ores were dressed and concentrated near the mines, however, in order to reduce the weight of impurities transported. In the case of copper, smelting of ore into an unrefined product ("blister"), which is then sold and transported for refining, is common. In the less developed countries where mining was increasingly concentrated, any smelting industry that arose tended to be integrated with and located close to mines, a rational arrangement in view of transport costs. Unlike the situation in the steel industry, smelting and fabrication of nonferrous metals may occur at widely separated points, generating considerable transportation of refined but unfabricated metals. In the past several decades, however, there are signs of a shift back toward integration of smelting and metal fabrication. Nonferrous metals smelters generally produce alloys as well as pure metals, depending on customer requirements.

1.09 Due to great differences in the resource endowments of different regions of the world, mining of most nonferrous metals is concentrated in a few countries. For instance, of the 24.6 million tons of bauxite produced in developing countries in 1968, the Caribbean region alone accounted for 19.2 million tons. A few countries also account for most production of copper and lead.[8/] On the other hand, production of refined metals and metal fabrication tend to be located close to the source of demand, in the industrialized countries. This split between mining and processing to some extent can be attributed to historical reasons. The location pattern that emerged from the early period of industrialization was reinforced by the colonization or economic subjugation of most underdeveloped parts of the world, including the main mining areas. More recently, cascading tariff rates in many industrialized countries give very high effective rates of protection to the later stages of processing and fabrication of nonferrous metals, which tends to preserve their separation from mining.

1.10 In addition to historical influences, location patterns in the world nonferrous metals industry are affected by a number of economic considerations. These vary in relative importance for the different metals. Transport costs and weight reduction at different stages in the production process can be very important. For example, in the case of copper, the metal content of most ores is so low that they have to be "concentrated" before being shipped any distance from the mine site. Bauxite, on the other hand, generally has a relatively high aluminum content, so the extra costs involved in shipping long distances before further processing are much smaller. Energy consumption is sometimes a crucial consideration in decisions on the location of smelting operations. Availability of cheap energy is the primary criterion for

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8/ United Nations, (1972, p. 6). The figure for bauxite presumably does not include China.

aluminum smelting, which is very electricity-intensive. The availability of infrastructure in the mining areas may also affect location choices.

1.11 Another factor which sometimes has an important impact on location is ability to respond to the needs of the users of nonferrous metals. Many if not most of them require specific alloys rather than pure metals. It is most economical for smelters to produce these alloys directly, since pure metals would have to be remelted by the users and mixed with the appropriate amounts of impurities (some of which are present in ores anyway).[9/] But many of the alloys produced by smelters must meet user specifications exactly and moreover often must be customized for different users or even for the same user at different times. From this perspective, nonferrous metals can be viewed as differentiated, sometimes customized products with exacting quality standards. In this situation, the need for close ties between smelters and the main users may provide an economic argument for locating smelter activities near the sources of demand rather than supply. However, such responsiveness could be achieved by other arrangements, even over long distances.

1.12 As a result of differential resource endowments and the production structure described above, there is large-scale international trade in most nonferrous metals ores (or concentrated ores). There is also a considerable amount of international trade in pure metals. World exports of nonferrous metals rose from US$3.6 billion in 1955 to $21.7 billion in 1976, an average annual increase (in nominal terms) of nearly 9%. This growth has been accompanied by some important structural shifts, including an increase in the share of developed countries in total exports from 55% to 60% and a decrease in that of developing countries from 34% to 25%.[10/]

1.13 Because of short-term inelasticities on both the demand and the supply sides, prices of nonferrous metals on the world market are highly volatile and show considerable cyclical fluctuations. For the most part price competition is fierce, and cartel-like pricing arrangements by producers are usually no more than temporarily successful in raising or stabilizing prices. Given the homogeneous nature of the products (in their pure form, with precise grading), marketing and sales promotion play a relatively minor role, so it is easy for new exporters to gain a foothold in the world market.

9/ This remelting would waste a considerable amount of energy, because of the need to reheat metals to high temperatures and also the duplication involving creating pure metals and then adding impurities (some of which had previously been removed) to form alloys of the appropriate specification.

10/ Muller-Ohlsen (1981, p. 193). The value figures are for SITC category 68 and include ores, concentrates, and smelter and refinery products.

China's Nonferrous Metals Industry

1.14 China has large mineral reserves of many nonferrous metals.[11/] Exploitable reserves of tungsten, antimony, rare earths, lithium, and magnesium are the highest of any country in the world, while those of tin, mercury, zinc, molybdenum, copper, lead, nickel, and titanium are also very large. Ores for the most important industrial metals like copper, lead, and zinc are found in most of China's provinces, with fairly concentrated reserves of copper in 13 provinces (Liaoning not among them) and heavy lead and zinc mining activity in six provinces (of which Liaoning is one). In the case of important metals for which world verified reserves are relatively low, like tin, tungsten, antimony, molybdenum, and magnesium, China's resources are concentrated in a few areas. This is especially true of rare earths, niobium, vanadium, and titanium, of which China has almost uniquely large deposits.

1.15 Reserves for the most part are located near abundant sources of energy (hydropower, petroleum, or coal), which would be convenient for energy-intensive smelting activities. On the other hand, these are often remote regions with difficult mining conditions and poor transport, which slows exploitation considerably. Another problem is that certain ores like cooper have a relatively low metal content, making extraction more difficult and costly. In any case, the potential advantages of abundant energy close to reserves for the most part have not been exploited (except to some extent in Gansu and Yunnan Provinces); most smelters appear to be located in coastal provinces far from both mineral reserves and energy sources.[12/] This location pattern is most probably highly inefficient from a national perspective, and it is not clear how or why it emerged.[13/] Indeed, it is striking that in the case of nonferrous metals, China has somehow broadly reproduced the location pattern of the world nonferrous metals industry. China does not even reap the primary economic benefit of locating smelters close to users, since

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11/ This discussion of mineral resources is based on Sun (1983, p. 193).

12/ Shanghai and Liaoning are the two provincial-level jurisdictions with the largest nonferrous metals smelting industries. In the case of copper, it appears that the two account for 35% of total national output of electrolytic copper, which is striking in view of the fact that 13 provinces (mostly in the western part of the country) have substantial reserves. See Table 1.2, Statistical Appendix, item 4, and Shanghai Academy of Social Sciences, (1983, p. 293).

13/ Since the nonferrous metals industry in China was very small prior to 1949, the situation cannot be blamed on historical factors except to a very minor extent. It may be that existing small smelters in places like Shanghai and Liaoning underwent massive expansion (perhaps initially depending on imports), and then "held on" to these relatively lucrative activities (which are much more profitable than mining given China's price structure). But if this is what happened, it indicates that national planning in the nonferrous metals industry must have been inadequate even in the 1950s.

Chinese smelters produce only pure metals and are forbidden to produce alloys.[14]

1.16 Output of the main nonferrous metals has grown rapidly in the past three decades. In China ten metals (copper, aluminum, lead, zinc, nickel, tin, antimony, mercury, magnesium, and titanium) account for nearly all physical output of nonferrous metals, and China's total production of them ranks sixth in the world.[15] From 1952 to 1979, production of these ten metals increased at an average annual rate of 10.6%.[16] During the same period gross output value of the nonferrous metals industry increased at 12.0% per year in real terms.[17] These figures can be compared with the 11.1% average annual increase in China's gross industrial output value and 13.4% growth of heavy industry output value in 1952-1979.[18] Growth of the nonferrous metals industry, like that of Chinese industry as a whole, has fluctuated greatly over time.[19]

1.17 Despite this rapid long-term growth, it is often claimed in Chinese publications that both investment in and output of nonferrous metals have been unduly low. For instance, the ratio of China's output of copper, aluminum, lead, and zinc to steel output in a recent year was 1:33, compared to a world average of 1:19.[20] In recent years, nonferrous metals have accounted for only about 2% of China's total capital construction investment.[21] It is probably true that China has underinvested in mining of nonferrous metals, particularly those which have rich deposits and good export markets. However,

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14/ This means that users must remelt the pure metals they are allocated and add impurities according to their required specifications. Users may not want to give up these activities because of the adverse implications for employment and profits. See pp. 58-60 for more details.

15/ Just four of these, aluminum, copper, lead, and zinc, account for over 90% of total output of nonferrous metals (Sun, 1983, p. 160). According to another report, these four metals account for about 96% of China's total consumption of nonferrous metals. See Li (1983, p. 273).

16/ "China Economic Yearbook" Editorial Committee (1981, p. IV-84).

17/ Ma (1982, p. 170).

18/ State Statistical Bureau, (1983, p. 17).

19/ Total output of copper, lead, zinc, and aluminum increased at an average annual rate of 23.7% during the First Five-Year Plan period (1953-1957), 4% during the Second Five-Year Plan period (1958-1962), 21.2% in the readjustment period (1962-1966), and only 2.4% per year during the "ten chaotic years" (1967-1976). See Li (1983, p. 271).

20/ Sun (1983, p. 160).

21/ State Statistical Bureau (1983, p. 330).

given the imbalances in resource endowments of different minerals and large-scale existing world trade in most of them, an investment strategy geared toward self sufficiency in every nonferrous metal would not make sense.

1.18 Copper, lead, and zinc are of particular interest for this case study. Table 1.2 shows estimates of production in China of these three metals along with that of aluminum. Since China does not publish any statistics on production of individual nonferrous metals, these figures are subject to error. Nevertheless, they indicate that China's production of copper, lead, and zinc grew rapidly from a tiny base in 1949, but that growth slowed in the 1970s and virtually stopped in the early 1980s. Growth of aluminum production apparently was very rapid starting in the late 1950s, but slowed down in the early 1980s.

1.19 In addition to the Shenyang Smelter, the main copper smelters are located in Kunming, Baiyin, Luoyang, and Shanghai, with Shanghai utilizing primarily scrap copper and imported blister. Lead and zinc smelters are located in Zhuzhou and Shaoguan, while Huludao (in Liaoning) is a large zinc smelter and a lead smelter is located in Kunming.[22/] In the case of sulphuric acid (an important product of the Shenyang Smelter), total production in China increased from 150,000 tons in 1952 to almost seven million tons in 1979, an average annual growth rate of over 15%.[23/]

1.20 The production and distribution of nonferrous metals in China is in principle controlled via the central plan. Of the 256 producer goods nominally subject to allocation by the central State Material Supply Bureau in 1979, 76 were nonferrous ores, metals, and metal products. Similarly, at least 30-40 of the 581 ministry-controlled materials in the same year consisted of nonferrous ores, metals, alloys, etc.[24/] But as is the case with other important producer goods in China, actual control over production and allocation is decentralized to a considerable extent. One-fourth of total mining output is from small mines under local governments.[25/] Moreover, scrap metals are not subject to allocation by the plan, unlike the situation for scrap steel, of which a large proportion is controlled by the State Material Supply

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22/ Sun (1983, p. 163).

23/ State Statistical Bureau (1983, p. 246).

24/ China Materials Economics Association, (1983, pp. 124-125, 132-133). One of the 30-40 ministry-allocated materials is rare earths, which includes 54 different items (not included in the total figure of 581). The 48 different types of rare earths subject to allocation by the State Material Supply Bureau are included in the 76 and in the total figure of 256.

25/ China Encyclopedia Editorial Committee (1983, p. 372).

Table 1.2: CHINA'S PRODUCTION OF ALUMINUM, COPPER, LEAD AND ZINC, 1949-1983 /a
('000 metric tons)

	Aluminum /b			Copper			Lead			Zinc	
	/c Bauxite	Aluminum oxide	Aluminum	Mine production /d	Smelter production /e	Refined production	Mine production /d	Smelter production /e	Refined production	Mine production /d	Smelter production
1949	-	-	-	-	2.2	-	-	-	-	0.2	0.2
1952	-	-	-	-	-	-	-	-	-	1	1
1953	-	-	-	8	-	-	9	-	-	-	-
1955	-	-	-	-	-	-	17	-	17.5	12.5	15
1957	50	-	10	15	15	-	30	-	45	37	37
1965	400	-	90	87/f	87/f	110/f	100	-	100	90	90
1970	500	270	135	120/f	120/f	130/f	110	-	110	100	100
1975	1,000	500	300	140	150	230	140	125	140	135	140
1978	1,400	700	360	160	170	290	150	140	160	150	160
1979	1,500	700	360	160	170	290	155	150	170	155	160
1980	1,700	700	350	165	175	295	160	145	175	150	155
1981	1,800	700	350	170	190	300	160	150	175	160	160
1982	1,950	800	370	175	205	300	160	155	175	160	175
1983	1,900	800	400	175	195	310	160	160	195	160	185

/a These are rough estimates. A blank does not mean that there was no production of the good concerned in that particular year, merely that no information is available.
/b Estimates for 1970 and earlier years are quite suspect since those for later years have been raised substantially.
/c Total weight, not taking into account metal content.
/d Metal content.
/e Not including secondary recovery.
/f Including production by North Korea.

Sources: Metal Statistics, various years; Schmitz (1979).

Bureau.[26] Thus a considerable share of total output of nonferrous metals is allocated outside the central plan. It is therefore not surprising that Shanghai Municipality, a large user of nonferrous metals, reports that 40% of the supplies it receives are outside the plan and at negotiated prices.[27]

1.21 As in the case of planning, prices of the main nonferrous metals in China are administratively fixed by the central government and are changed only at rare intervals. For example, the price of electrolytic copper has remained the same since 1962, while that of electrolytic aluminum has been unchanged since 1966.[28] However, there appear to have been significant increases in the state-set prices of certain nonferrous metals in recent years, including a 27% rise for molybdenum and a 79% increase for tin.[29]

1.22 Prices of goods traded outside the central material supply plan appear to have considerable flexibility, with sales offers even posted in specialized newspapers (at least since 1984). For example, the "negotiated price" of molybdenum is reportedly 31% higher than the state price (which itself was sharply raised recently). The negotiated price of tin is 75% above the state price, that of copper as much as 24% higher than the state wholesale price.[30] On the other hand, the price of lead on the open market may be slightly below the state price.[31] Strict price controls appear to be applied only to that part of supply allocated by the central material supply plan. At the opposite fringe, some transactions in nonferrous metals seem to occur at essentially market-determined prices. In between there is a large group of transactions for which prices are to some degree administratively controlled (often by provincial and local authorities), with price controls being subverted indirectly by means of various kinds of barter deals or tied transactions.

1.23 Available information on the administratively-fixed domestic prices of various nonferrous metals in China is presented in Table 1.3. Comparison with world prices is difficult because the latter have been very volatile while Chinese prices appear to have remained largely stable. In this context

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26/ China Materials Economics Association (1983, p.124). Scrap steel is brought into the central material supply plan by means of quotas for different regions, enterprises, etc. to deliver certain quantities of scrap to the government. The rest is distributed outside the central plan.

27/ Hu and Liu (1984, p. 67).

28/ Yan (1985, p. 436).

29/ Hu and Liu (1984, p. 67).

30/ Hu and Liu (1984, p. 67), and Table 1.3. Also (for free-market price of copper) see Shanghai Wuzi Shichang, No. 180, 8/4/84, p. 2.

31/ Shanghai Wuzi Shichang, No. 176, 7/7/84, p. 2, and No. 180, 8/4/84, p. 2.

Table 1.3: CHINESE NONFERROUS METALS PRICES

	Ex-factory price /a (Y/ton)	US dollar price /b ($/ton)	International price /c ($/ton)	Domestic-international price ratio (Y/$)
Ores				
Tungsten (65%)	9,685	3,459	5,277/d	1.84
Molybdenum (51%)	16,320	5,829	8,863/d	1.84
Metals				
Electrolytic copper	5,500	1,964	1,755	3.13
Zinc ingot	1,900	679	862	2.20
Aluminum ingot	2,760	986	1,264	2.18
Pure tin (1) /e	12,650	4,518	14,375	0.88
Pure tin (2) /e	18,500	6,607	14,375	1.29
Lead /f	2,300	821	737	3.12
Antimony	3,470	1,239	2,011/d	1.73
Cadmium	19,000	6,786	3,117	6.10

/a Price paid by Chinese customers (including commercial and foreign trade procurement agencies) to producers. However, there are various types of "free market" prices for some of these goods, which can differ substantially from these state-set prices.

/b Converted at the rate of Y 2.8 to US$1.00.

/c Unless otherwise indicated, these are cash prices at the London Metals Exchange, the average prices in 1981. Figures were converted from pounds sterling into US dollars at the average exchange rate for 1981.

/d These figures are from a Chinese source and it is not clear whether they are comparable with the London Metals Exchange prices.

/e It appears that the price of tin was raised in the early 1980s.

/f Estimate based on a report that the price ratio for tin to lead was 5:1 (and a reported tin price of Y 11,500/ton).

Sources: Shanghai Means of Production Service Company (1981, p. 56); Hu and Liu (1984, p. 67); Wu (1982, pp. 41-43); Metallgesellschaft AG, (1984, pp. 385-416); World Bureau of Metal Statistics (1984, p. 64); International Financial Statistics, 38(8), August 1985, p. 111.

it should be remembered that world prices in 1981 (a recent year arbitrarily picked for the world price figures shown in the table) tended to be on the high side for most nonferrous metals. Another problem is the considerable decline in the value of the Chinese renminbi against the US dollar and other major foreign currencies in the early 1980s. The exchange rate used (the former internal settlement rate of Y 2.8 to US$1) results in lower US dollar-equivalent Chinese domestic prices than if the official exchange rate in a recent year had been chosen.[32/] Thus both the choice of the internal settlement rate and the use of 1981 world market prices would tend to make Chinese prices seem lower in relation to world prices.

1.24 In view of this bias, the comparisons in Table 1.3 are all the more striking. Only in one case, tin, is the Chinese domestic price of a refined metal seriously out of line with world prices on the down side. In some cases like copper and lead, Chinese prices exceed world prices by a considerable margin.[33/] In other cases where world prices moderately exceed domestic dollar-equivalent prices (zinc and aluminum), use of a different exchange rate or international prices of a different year would probably change the results. On the other hand, domestic ore prices are probably much lower in relation to world prices, based on the information on tungsten and molybdenum in the table and the general pattern of mining earning very low profits in China (even losses) compared with smelting and refining.

1.25 Given administrative controls over foreign trade and other major price distortions, comparison between domestic and world prices does not give an entirely accurate picture of relative scarcities or the supply situation in China, aside from questions about the choice of an appropriate exchange rate. A good example is copper. The domestic price appears to be moderately higher than the world price, which would mean abundant supplies if there were free trade, even with a substantial tariff. But with controls over imports, the relative scarcity of copper depends in large part on China's endowment of mineral resources; in this situation the price of copper may be too low. Another problem is that copper is underpriced in relation to fabricated copper products.[34/]

32/ However, after a gradual decline over a period of many months, China's official exchange rate has fluctuated in the 2.8-2.9 range since early 1985, which means that use of the 2.8 rate may be appropriate in the present situation.

33/ The Chinese domestic price of cadmium seems much too high in relation to world prices, but this price may not be used in many transactions. The Shenyang Smelter reported that the actual market price of cadmium had fallen below Y 10,000/ton, which would translate into a dollar value not much above the world price.

34/ The Shenyang Smelter's profit per ton of copper smelted is about Y 700, including some indirect taxes (Statistical Appendix, item 42, and ex-factory price data in Table 1.3). But the profit from fabricating one ton of aluminum-copper alloy rods (which must involve little extra effort),

1.26 Historical data on China's main exports and imports of nonferrous metals are shown in Table 1.4. Generally imports have been more volatile than exports, which is not surprising if the latter are used to meet targets for foreign exchange earnings while the former are used to fill gaps in (also volatile) domestic supplies. One interesting development is a sharp increase in copper imports, which more than tripled in 1982 and again more than tripled in 1983. Part of this rise can be explained by a revival in domestic investment demand after the severe cutback in 1981, but it may also reflect a government decision to give lower priority to development of copper mining, in view of the relatively poor quality and high cost of extraction of China's copper resources.[35/] If this is indeed the case, recent trends in China's copper imports are highly relevant for the future of the Shenyang Smelter.

1.27 More detailed information on exports and imports of nonferrous metals in recent years, presented in Tables 1.5 and 1.6, shows a varied pattern. Exports of aluminum ores and imports of aluminum have both increased sharply. This is not true of zinc and copper, for which imports of pure metals and alloys have risen sharply while exports of fabricated products have stagnated (copper) or declined sharply (zinc). Tungsten exports have been volatile, perhaps reflecting changes in China's foreign trade management (see p. 69). Exports of most nonferrous metals increased in 1984 while imports of all but zinc declined considerably, despite the acceleration of economic growth and consequent increase in domestic demand in 1984. This only shows that due to the size of China's economy, there need be no close relationship between domestic developments and international trade in the short run.

1.28 China's long-term plans for development of the nonferrous metals industry call for total output of the ten most important metals to rise by 180% between 1980 and 2000, for an average annual increase of 5.3%.[36/] This is somewhat slower than past long-term trends, but considerably higher than the average rate of growth in recent years.[37/] Given the ambitious goal of quadrupling China's gross output value of industry and agriculture between

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is over Y 1,300/ton, while that from producing tubes or sections is over Y 3,000/ton.

35/ See Sixth Five-Year Plan (1984, pp. 104-107) which states that copper production will be developed "where conditions are suitable." Li (1983, p. 273) argues more specifically that developing production of aluminum, lead, and zinc is more economically efficient than developing copper production. Investment requirements per ton of copper mined are twice as high as for aluminum and four times as high as for lead or zinc.

36/ Li (1983, p. 272).

37/ Output of the ten important nonferrous metals increased by only 4.1% in 1981 and 3.9% in 1983. See China Encyclopedia Editorial Committee (1982, p. 354) and "China Economic Yearbook" Editorial Committee (1984, p. V-153). Apparently no exact information was published on the growth of output in 1982, but though it exceeded plans it must have been very low. See "China Economic Yearbook" Editorial Committee (1983, p. IV-96).

Table 1.4: EXPORTS AND IMPORTS OF NONFERROUS METALS, 1950-1983 /a
(Metric tons)

	Exports				Imports		
	Tungsten ore	Tin	Antimony	Mercury	Copper	Aluminum	Lead
1950	8,800	4,800	4,900	2	13,900	3,000	800
1952	21,800	7,900	10,000	13	8,400	1,900	400
1955	31,900	20,400	9,900	326	11,500	3,400	10,200
1957	35,400	25,700	5,800	499	17,700	3,700	6,100
1960	25,200	26,200	7,400	1,697	73,900	22,000	2,900
1962	25,400	20,000	7,300	1,720	8,100	9,300	3,000
1965	20,900	10,100	5,100	347	67,000	4,200	24,000
1967	16,300	5,800	7,900	153	96,300	53,800	16,300
1970	8,200	7,700	2,400	118	132,000	91,600	51,200
1972	16,300	11,600	10,600	169	101,200	111,700	11,900
1975	14,300	15,200	8,100	357	112,500	287,100	52,300
1976	20,500	7,800	6,600	557	67,300	300,100	28,800
1977	13,600	5,600	7,700	795	91,200	150,500	14,000
1978	18,200	5,500	11,500	659	134,100	211,800	28,600
1979	21,300	4,600	12,500	492	134,200	146,100	35,200
1980	20,400	4,200	8,900	985	128,200	110,200	33,800
1981	22,100	3,400	7,200	946	46,600	46,100	35,100
1982	10,600	2,900	10,100	476	152,400	209,300	13,800
1983	23,900	3,200	10,000	496	522,700	301,400	12,300

/a These are exports and imports handled by foreign trade departments. Since the late 1970s, an increasing share of trade in nonferrous metals has been arranged by ministries and provincial or local governments.

Source: State Statistical Bureau (1984, pp. 407, 409).

Table 1.5: MAIN EXPORTS OF NONFERROUS METALS, 1981-1984 /a

	1981		1982		1983		1984	
	Volume (Metric tons)	Unit value (US$/ton)	Volume (Metric tons)	Unit value (US$/ton)	Volume (Metric tons)	Unit value (US$/ton)	Volume (Metric tons)	Unit value (US$/ton)
Aluminum ores /b	22,708	105	27,588	94	57,001	72	81,828	72
Tungsten ores	26,389	8,652	11,188	7,088	24,990	5,454	18,860	5,172
Tungsten	600	13,069	183	14,293	65	18,985	79	14,950
Tungsten products	16	18,328	11	24,548	22	31,725	n.a.	n.a.
Antimony	8,213	2,935	13,432	2,132	12,216	1,921	17,321	2,864
Zinc and zinc alloys	17,474	838	10,181	718	2,051	730	1,454	895
Tin and tin alloys	5,614	11,210	3,643	11,025	3,068	12,082	2,641	12,388
Copper products	8,123	1,824	9,488	1,673	6,596	1,770	7,720	1,746
Aluminum products	11,593	1,568	10,552	1,550	9,721	1,224	5,951	1,748

/a These figures are based on customs statistics so they differ from those in Table 1.4, which are based on data from the Ministry of Foreign Trade. Moreover, product categories also differ somewhat. Unit values were calculated from value and volume data and converted into US dollars at the average exchange rate for the year concerned.

/b Including bauxite.

Source: State Statistical Bureau, (1983, pp. 413, 415, and 1984, pp. 389, 391); China's Customs Statistics, 1985, No. 1 (April 1985), pp. 25, 27, 28.

Table 1.6: MAIN IMPORTS OF NONFERROUS METALS, 1981-1984 /a

	1981		1982		1983		1984	
	Volume (Metric tons)	Unit value (US$/ton)	Volume (Metric tons)	Unit value (US$/ton)	Volume (Metric tons)	Unit value (US$/ton)	Volume (Metric tons)	Unit value (US$/ton)
Chromium ore	80,079	108	224,841	108	307,479	99	280,687	92
Copper and copper alloys	53,689	1,841	110,938	1,599	485,863	1,895	254,045	1,473
Aluminum and aluminum alloys	57,772	1,488	169,566	1,115	283,756	1,341	252,736	1,385
Zinc and zinc alloys	12,409	749	108,084	841	228,708	776	230,178	991

/a Based on customs statistics. See footnote /a, Table 1.5.

Source: State Statistical Bureau, (1983, pp. 418, 419, and 1984, pp. 393, 394); China's Customs Statistics, 1985, No. 1 (April 1985), pp. 32, 33.

1980 and 2000, consumption of nonferrous metals may well rise faster than production, necessitating increased imports. Top priority reportedly will be given to developing aluminum production, despite problems because of high electricity consumption in smelting. Lead and zinc will also be developed, but copper will receive lower priority as was already mentioned. These priorities are based on reported investment requirements per ton of (presumably annual) copper production which are four times those of aluminum and twice those of zinc and lead.[38/] However, it is not clear whether a careful evaluation has been made of the choice between domestic mining and importing for each main metal, using economic analysis with appropriate shadow prices.

Brief History of the Shenyang Smelter

1.29 The Shenyang Smelter is located in Shenyang, the capital of Liaoning Province and the largest city in Northeast China. Then known as the "Fengtian Metal Smelter," it was established in the 1930s during the Japanese occupation of Manchuria. It first smelted lead in 1936, and began producing copper in 1939. Unsuccessful attempts to smelt zinc occurred in 1944-1945. During the period of Japanese occupation, technology was backward and production was very low (only 2,160 tons of electrolytic copper, 180 tons of copper sulfate, and 6,800 tons of lead in the year of maximum production). The plant was taken over by the Kuomintang government in March 1946 and renamed the "Shenyang Smelter." But production never really revived; in 1948 output of copper was only 70 tons.

1.30 Shenyang City was brought under Communist control in November 1948, and two months later production resumed at the Shenyang Smelter, which became the first major nonferrous smelting plant in the People's Republic of China. Electrolytic lead and copper were the first products, but in 1951 hydrosmelting of zinc was successfully experimented with and in 1952 over 2,000 tons of electrolytic zinc were produced. Copper, lead, and zinc (so-called "heavy" nonferrous metals) have continued to be the mainstay of the Shenyang Smelter's production in the three decades that followed. By 1953 peak output of the pre-1949 period had already been surpassed.

1.31 Production continued to grow rapidly thereafter; from 1949 to 1982 the smelter's gross industrial output value increased at an average annual rate of almost 12% in real terms, reaching Y 684 million in 1982. The

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38/ Li (1983, p. 273). Based on the international relative prices shown in Table 1.3 and other things being equal, it would make sense for China to invest in aluminum rather than copper, since the price of the latter is only 50% higher than that of the former. But the extremely high electricity consumption in production of pure aluminum, over 20,000 Kwh/ton, must be taken into account. The choice between copper and lead or zinc is much less clearcut, since prices of the latter are less than half that of the former, and moreover electricity consumption in zinc smelting is much higher than for copper or lead (Statistical Appendix, item 36).

capacity of the main production lines was greatly increased and the level of mechanization raised (which also resulted in improved working conditions). Present annual production capacity is over 50,000 tons of copper, over 50,000 tons of lead, and 20,000 tons of zinc. In 1982 the Shenyang Smelter apparently accounted for about 24% of total national production of copper, 29% of lead, and 9% of zinc.[39] Quality of output also has improved considerably.

1.32 In line with the growth of production, employment at the Shenyang Smelter rose to 6,770 in 1982. In addition there were 5,768 workers under the "collective ownership system," primarily children of smelter employees. Of these, about half worked alongside regular state employees in the plant's main production facilities, while the other half were engaged in various services and construction activities organized by two collective enterprises established by the smelter (see p. 40). The original value of the plant's fixed assets reached nearly Y 178 million by 1982 (up from Y 109 million in 1975); the depreciated net value of fixed assets was only Y 72 million, an indication that a large proportion of the capital stock was aging. Annual profits were over Y 50 million in 1980-1982, giving a relatively high financial rate of return on capital.[40]

1.33 Recovery of byproducts in the smelting process gradually assumed greater importance. This started in the 1950s with the recovery of certain metals from ores, like bismuth (1952), cadmium (1953), indium and selenium (1956), and tellurium, palladium, and platinum (1958). By 1980 a total of 14 byproducts were being recovered, including gold, silver, nickel, sulfur, antimony, and germanium in addition to those already mentioned. One of the most important "sideline activities" of the smelter is production of sulfuric acid (whose development started in 1969), which is now a major product of the plant, with annual production capacity of about 110,000 tons. Though they only account for about 8% of the total output value of the Shenyang Smelter, byproducts and subsidiary metals recovered from ores make an important contribution to profits, providing over 40% of the total.[41] Indeed, increased output of gold, of which 428,000 troy ounces was produced in

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39/ This is based on the information in Tables 1.2 and 1.7. As has already been mentioned, the figures on national production are unreliable. In particular, they may understate copper production.

40/ The total value of "quota circulating assets" (inventories of inputs and outputs and goods in process) was Y 112 million in 1982 (Statistical Appendix, Item 14). Using the original value of fixed assets plus quota circulating assets as the denominator, the financial rate of return was over 17%; if the net depreciated value of fixed assets is used instead, the financial rate of return rises to 27%.

41/ See State Economic Commission (1983a, p. 338).

1980,[42] or a sharply higher price for it,[43] or both, may have been major factors in the tripling of the smelter's profits between 1978 and 1981 (see Table 3.2). One article on the Shenyang Smelter lists gold and silver as main products, in addition to copper, lead, zinc, and sulfuric acid.[44]

1.34 From 1949 until the late 1960s the Shenyang Smelter was under direct central government control, first under the Ministry of Heavy Industry (which was soon abolished), later under the Ministry of Metallurgy (for a time under a Northeast Nonferrous Metals Administration which also was abolished). Though production was under central jurisdiction, the plant's Communist Party affiliation was with the Shenyang Municipal Party Committee. But appointment of the plant's leadership was subject to final approval by the Organization Department of the Central Committee of the Chinese Communist Party.

1.35 During the Cultural Revolution, as part of a national decentralization campaign the Shenyang Smelter was transferred downward from central to local control. In 1970 it was put under Liaoning Province, in 1971 under Shenyang Municipality. Thus its direct supervisory unit (previously the bureau responsible for nonferrous metals in the Ministry of Metallurgy) became the Shenyang Metallurgy Bureau. But this decentralization, as in so many other Chinese enterprises, was very uneven across different spheres of activity, creating the problem of so-called "multi-headed leadership." Financial and labor control were successfully taken over by the municipality, but supply of the main raw materials (which came from all over China) and therefore production planning remained very much under central ministry control. Distribution of output also remained largely under the control of central authorities. Supplies of certain key subsidiary materials and energy were handled by Liaoning Province. Thus multi-headed leadership became a key feature of the enterprise's management system and generated severe difficulties in planning, incentives, and control. Though the problem of multi-headed leadership is

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42/ State Economic Commission (1983a, p. 337). The figure given in this source is 323,600 liang (Chinese ounces), which was converted to ordinary ounces (avoirdupois) at the rate of 1.7637 and then to troy ounces at 0.75.

43/ The price paid for gold by China's banking system was raised from Y 95 per liang (Y 125.66 per troy ounce) to Y 406.25 (Y 537.38 per troy ounce) on March 1, 1980. At the same time the procurement price of silver was doubled. See Zhongguo Jinrong, 1980, No. 3 (March 30, 1980), p. 40, and also Shanghai Municipal Radio Service, June 11, 1980 (translated in JPRS China Report: Economic Affairs, No. 67, July 2, 1980, p. 42). However, it is not clear whether this very sharp increase applied to enterprises producing gold as well as gold offered for sale by individuals and rural collectives. Even the procurement price for newly produced gold reported for the late 1950s (Y 130 per liang or Y 171.96 per troy ounce) would mean substantial revenues for the Shenyang Smelter at the reported 1981 production level. See State Council (Volume 6, 1981, pp. 403-409).

44/ State Economic Commission (1983a, p. 337).

very common in China, the two stages of decentralization that the Shenyang Smelter went through and its national orientation (in production and supply) make this an extreme example.

1.36 A second key point about the smelter's historical development is that by the mid 1970s it had apparently reached a "plateau" in its primary production activities. This can be seen from Table 1.7, which shows physical output of main products. 1982 output of copper and lead were only slightly higher than the levels reached in 1975-1976, while there was some decrease in zinc output over this period. Sulfuric acid production depends to a large extent on the sulfur content of the ores smelted, but here too the limits of what could economically be recovered may have been approached in the early 1980s.

1.37 A final point worth noting is that the Shenyang Smelter developed on one site in increasingly urbanized surroundings, and that expansion in the immediate area became impossible after a certain point because of nearby industrial developments. Thus the smelter faced a severe space constraint, and moreover its urban location meant that the pollution it caused had very high social costs.

Table 1.7: THE SHENYANG SMELTER'S OUTPUT OF COPPER, LEAD, AND ZINC, 1975-1982
(Metric tons)

	Electrolytic copper	Electrolytic lead	Electrolytic zinc
1975	45,616	48,200	20,026
1976	47,285	51,433	17,612
1977	36,315	50,563	16,134
1978	46,154	47,808	20,727
1979	50,242	47,377	21,513
1980	56,547	51,489	17,691
1981	51,938	55,024	17,723
1982	48,654	57,255	17,235

Source: Statistical Appendix, item 4.

II. MAIN PROBLEMS FACED IN RECENT YEARS

2.01 The Shenyang Smelter has suffered from a number of serious problems of growing severity since the late 1970s. These have so dominated the plant's environment that its evolution in the past half decade or more is best understood as a set of responses to problems rather than as a function of reforms, policy changes, or organizational changes it underwent. The Shenyang Smelter tried its best to adapt to worsening circumstances and a difficult external environment; it could not remake or sharply change that environment. Thus its stance (it could hardly be called a conscious, thought-out strategy) was fundamentally passive, focused on survival and making it through from day to day rather than expansion and aggrandizement. This defensive approach was probably more a result of the environment and constraints faced than of managerial attitudes or capabilities.[1/]

2.02 One feature of the situation which made all the problems more difficult to deal with was the fact that the Shenyang Smelter had already gone a long way toward fully developing its potential on its existing site with its existing facilities (even augmented by moderate amounts of new investment). As has already been mentioned, production of the main metals (lead, copper, and zinc) had reached a plateau by the mid-1970s. Profits continued to rise until 1980 but then stabilized at just over Y 50 million annually, before declining sharply in 1983. The plant may have largely exhausted the potential for developing new products through comprehensive recovery of byproducts from ores, after years of vigorous activity in this area. Slack and waste in the system that easily could be eliminated to increase profitability was probably taken care of in the initial years of reform implementation (1979-1981). Another important factor at work in the early 1980s was inflation in the prices of various inputs. All in all, particularly after 1981, the enterprise had little room to maneuver in responding to a worsening situation.

2.03 Some problems like pollution were longstanding, but have been aggravated by changes in attitude on the part of authorities, by organizational changes (which themselves were responses to other problems), and by increased urbanization in the locality. Others like location are fundamental in nature, and can be solved only by drastic measures beyond the ability of the enterprise to undertake on its own. Still others like energy consumption are more amenable to technical improvements. Finally, some problems, like those with the multi-headed leadership system, the shortage of investment funds, or inability to produce alloys, are directly related to the economic system or to policies followed by central or local authorities. The same is true of the burden of employing the large number of workers' children. This chapter will discuss the main problems faced by the Shenyang Smelter since the mid-1970s, trying to ascertain their source and answer the question as to why

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1/ Indeed, one of the leading cadres of the Shenyang Smelter rose from deputy director in charge of production to director (through election by the workers) and then to deputy mayor of Shenyang municipality within a period of one year.

they all came to a head in the early 1980s. The interactions among the different kinds of problems are especially important.

Location

2.04 In a certain sense the fundamental problem faced by the Shenyang Smelter is its location, which may have been aptly chosen when the factory was first established but has become an increasing liability over time. The plant is hemmed in on all sides by other industrial establishments that have grown up since the 1950s, with a restricted site that leaves little or no room for expansion and exacerbates problems with storage and sorting of ores. It is located in a region where electric power output has been growing relatively slowly and which has a growing energy shortage. Finally, it is by far the worst polluter in Shenyang, which itself is one of the largest, most heavily industrialized cities in China.

2.05 The problem that impinges most directly on the Shenyang Smelter's decisionmaking and prospects is the physical constraint at the existing (or any nearby) site. Many other factories in China face similar space constraints at their original site, and some have responded by moving part of their production elsewhere and acquiring additional land, often through associations and mergers with other enterprises or rural collectives.[2/] But the option of expansion through partial relocation and farming out of part of the production process appears not to be available to the Shenyang Smelter. This may be due to the vertically integrated nature of the production process, or simply the capital intensity of the production technique (as well as immobility of the large capital structures involved). This second factor might make it inappropriate to move facilities unless large new investments were being made, which suggests an interaction between space constraints and shortages of investment funds (see pp. 35-39 below). Financial constraints may also make land acquisition more difficult.[3/] Moving one of the three main production lines to another site may not be economical if the sulfuric acid facility serves all three (and there are economies of scale in sulfuric acid recovery).

2.06 Despite these possible economically sound rationales for not expanding in this way, there may also be other reasons why the Shenyang Smelter has not taken this route. The enterprise's management may not have explored this option fully, particularly the possibility of associations with

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2/ The Chongqing Clock and Watch Company's extensive associations and mergers since 1980 were motivated in part by a desire to acquire additional land due to a space constraint at the original production site. See Byrd and Tidrick (1983, p. 20). Many enterprises in the crowded industrial center of Shanghai engage in joint ventures with suburban units for the same reason.

3/ Although there is no market for urban land in China, enterprises wishing to acquire land must provide compensation in various forms to the unit giving up the land. Recently it appears that such costs of acquiring land have been rising sharply.

rural collective firms, which presently recycle large amounts of scrap copper in small-scale inefficient operations which yield low quality output.[4/] It is also possible that associations and mergers may not yet be accepted ways of doing business in Liaoning or in Northeast China as a whole, unlike the situation elsewhere.[5/] Associations and mergers generally entail a commitment to provide employment for a certain number of people in the partner unit. This would be difficult for the smelter to do, since it already has its hands full taking care of the employment needs of the large number of its own workers' children coming into the labor force. In any case, even if expansion through partial relocation is ruled out, shutting down the entire facility and moving all production elsewhere may still be the best option from a national perspective (see pp. 60-63). Pollution considerations (discussed in the following section) powerfully reinforce this argument.

2.07 Other disadvantages of the Shenyang Smelter's location may be just as costly or even more costly from a social perspective, but they are less threatening to the enterprise's future development prospects. Moreover, the smelter does not bear the full burden of these costs itself. Other than pollution (discussed in the following section), the main problem areas are raw material and energy supplies.

2.08 Liaoning Province's copper, lead, and zinc mines can satisfy only 30% of the province's smelting capacity.[6/] Since the Shenyang Smelter accounts for the bulk of smelting of these metals in the province, it must obtain most of its raw materials from distant sources. However, it is not clear to what extent the smelter pays the full costs of the long-distance transport required. Though railway freight costs are normally factored into prices of raw materials bought by Chinese enterprises, tariffs are far below market clearing levels given the severe shortage of railway transport capacity, and the method of calculating costs may understate them for hauls of longer than average distances.

2.09 The location of the plant is not ideal from the viewpoint of using imported raw materials, either (these accounted for about 27% of its total supplies of copper ore and 40% of blister in 1984). Shanghai, for instance, has built up a large copper smelting industry based mainly on imported ores

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4/ There are reportedly more than 30 small copper smelters recycling scrap in Liaoning Province alone. Their product often has a copper content of only 80-90%, and copper losses in production are as high as 20%.

5/ Neither of the other two enterprises in the sample located in Northeast China got extensively involved in associations and mergers with other enterprises, though both of them set up collective enterprises of their own to employ workers' children (as did the Shenyang Smelter).

6/ See Zhu (1983, p. 56). For more information on the smeltery's scattered sources of supply, see p. 27.

and recycling scrap copper.[7/] It at least has the advantage of being a port, so that domestic transport costs for imported raw materials are relatively low; it may also be a good source of scrap copper because of its large industrial base. The Shenyang Smelter, by contrast, is located a considerable distance from the coast.

2.10 Originally the enterprise must have been well-sited from the viewpoint of energy and electricity supplies, since coal and hydropower were developed in Liaoning during the period of Japanese occupation. But Liaoning now is a large net importer of coal,[8/] and electricity supplies have grown much more slowly in Liaoning than in other parts of China in recent years.[9/] Particularly with the development of electricity production in interior provinces with more abundant ore reserves, the siting of the Shenyang Smelter made less and less sense from the viewpoint of energy and raw material supply sources as time went on.

2.11 Though smelting of nonferrous metals is highly energy intensive and electrolysis requires large amounts of electricity, the smelter has not been forced to bear the brunt of Liaoning's severe shortages of coal and electricity, even though both of these inputs are to a large extent subject to provincial allocation. The Shenyang Smelter appears to have benefitted from the diversion of power supplies to it from the Fushun Aluminum Plant, which is an even bigger consumer of electricity. The total allocation of electricity to the nonferrous metals industry in Liaoning has declined, but the share of the Shenyang Smelter in this reduced flow has increased, allowing it to maintain a constant absolute volume of electricity usage (see Statistical Appendix, item 35). As a large, locally very important enterprise, the plant undoubtedly also gets help from local authorities in arranging energy and especially electricity supplies.

Pollution

2.12 Perhaps the most threatening aspect of the location problem, however, is the micro-geographical one of pollution. The Shenyang Smelter is the worst polluter in the highly industrialized city of Shenyang; it accounts for 45% of all the sulfur dioxide discharged in the city, 50-80% of the heavy

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7/ In 1982 Shanghai produced 56,000 tons of electrolytic copper (somewhat more than the Shenyang Smelter's peak annual output) and 69,000 tons of copper products. See Shanghai Academy of Social Sciences (1983, p. 293).

8/ Shipments of coal into Liaoning under the central plan in 1981 were 19.94 million tons, compared to total provincial production of 33.7 million tons and shipments out of the province of only 920,000 tons. See Ministry of Coal Industry (1983, pp. 17, 24).

9/ In 1957-1982, total electricity output in China as a whole grew at an average annual rate of 12%, in Liaoning by a little over 7%; for the period 1978-82 the figures are over 6% and under 2%, respectively. See State Statistical Bureau (1983, p. 244) and Zhu (1983, p. 380).

metals in waste water, and 95% of all arsenic released. Highly toxic cadmium in the factory's waste water has contaminated large amounts of farmland in Shenyang's suburbs. The impact of pollution on the people of Shenyang is exacerbated by the lack of urban zoning in China and the responsibility of enterprises to provide housing for their workers, which means that factories and residential housing are intermingled.

2.13 The pollution problem was recognized as long ago as 1953, and the smelter has been criticized for its pollution by local governments and representative assemblies. But until 1978 pollution was growing worse rather than better, and apparently there was little effort to control it, though comprehensive utilization of byproducts (e.g. cadmium and sulfuric acid) must have helped limit pollution. The very fact that sulfuric acid recovery (an almost universal practice in nonferrous metals smelters worldwide) was not developed until the 1970s provides a strong indication that pollution was not taken seriously.

2.14 The Shenyang Smelter was able to avoid taking extraordinary and costly measures to control pollution in part because national policies on industrial pollution were lax for a long time. Another reason may have been the decentralization of the factory to municipal jurisdiction, which meant that the government of the area which suffered from the pollution at the same time benefitted from the profits and other contributions (e.g. in providing employment) of the smelter. Conversely, when the plant was put under the central government in 1983, the local government started levying heavy fines for water pollution and in general increased its vigilance.[10/] Similarly, the demands for more aggressive pollution control became stronger as national anti-pollution policies hardened and local government concern for popular welfare increased, even though actual pollution by the factory may not have increased much since the mid-1970s (when production reached a plateau).

Raw Materials and Energy Supply

2.15 The Shenyang Smelter's raw material supply problems are not solely related to its distance from mines. For lead and copper, the plant's sources of raw materials are remarkably scattered. Copper concentrate comes from 33 different mines in 9 different provinces, while lead concentrate comes from 51 mines in 12 provinces. Only in the case of zinc is the plant more fortunate: prime processed zinc ore all comes from a single supplier which is located within Liaoning Province. It is very difficult for the smelter to regulate the incoming flow of copper and lead ores, since the shortage of railway transport capacity makes delivery schedules unreliable. Moreover, mines are unable to maintain steady production, and this is exacerbated by the impact of weather conditions on mining and transport. Also, allocations of

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10/ Before 1983, no fines for water pollution were levied on the smelter, even though existing regulations called for such fines. In 1983 a fine of Y 5 million was levied, in 1984 Y 6.2 million. This was most probably related to the changes in administrative jurisdiction of the factory that were occurring at the time.

raw materials (particularly imports) are finalized rather late, adding to uncertainty.

2.16 Since these raw materials were allocated by the Ministry of Metallurgy (now by the Nonferrous Metals Industry General Corporation), there was the danger of supply interruptions due to decisions by the central government, as well as possibly obstruction by local authorities in the mining areas. It appears that in 1983, when there was a conflict between central authorities and Shenyang Municipality over putting the Shenyang Smelter under central jurisdiction, ore supplies and imported raw materials were held back, making it difficult for the smelter to fulfill its plans.

2.17 The irregular delivery of raw materials and the lack of space at the Shenyang Smelter's production site combine to create a serious problem in storage and sorting. Since shipments of concentrate from different mines are of varying degrees of purity and have different byproducts, they ideally should be kept separate so that they can be processed separately. But because of space restrictions the smelter cannot do this; at best it can put the copper concentrate from 33 mines in 4 different piles, at some cost in production efficiency. Similar problems exist with lead ores.

2.18 The supply situation for copper is complicated by an imbalance in the smelter's capacity at different stages of the production process. Its capacity for smelting ore into unrefined copper ("blister") is at most 25,000 tons per year, while its capacity for refining and electrolysis (the final stages in producing pure copper) is 60,000 tons per year. Thus it cannot use additional concentrated ore beyond a certain point but rather requires either blister or scrap copper. Though relative prices make smelting concentrate more profitable than processing blister, the former requires more energy than the latter. At present the Shenyang Smelter is operating at or very near production capacity in processing concentrate into unrefined copper, but considerably below capacity in transforming unrefined copper into pure electrolytic copper.[11/]

2.19 The Shenyang Smelter's reliance on imported raw materials further adds to uncertainty. Though shipping and delivery should be more reliable than in the case of domestic raw materials, the quantity of imported ore and especially blister the smelter is to receive is not determined until relatively late in the plan year. It appears that imports, particularly of blister, are used as a "balancing item," filling in (or at least partially covering) the gap between needs and domestic supply allocations. But this is confused by the fact that the smelter essentially has two different output and supply plans as a result of the multi-headed leadership system (see pp. 32-33). The "state" output plan is essentially covered with adequate raw material supply allocations, but the local plan (set by the Shenyang Metallurgy Bureau and considerably higher than the state plan) is not.

11/ This observation is based on the fact that copper ore supplies in 1983 totalled over 24,000 tons (compared with production capacity of 24,000-25,000 tons).

Supplies of domestically produced blister also appear to be highly uncertain and tend to be finalized late in the year.

2.20 The most important source of supply with which to increase output above the state plan target is scrap copper for recycling. But scrap copper (unlike scrap steel) is not subject to central state allocation, and thus none is provided to the Shenyang Smelter in its input plan. On the contrary, different organizations vie to procure scrap, and the market is very tight, resulting in price escalation to the point where some scrap is sold for as much as Y 5,500 per ton (the state price of pure copper) or even more. The smelter is at a severe disadvantage in this situation, for several reasons. The need to earn a profit prevents it from bidding too high,[12/] but small rural scrap reprocessors apparently are less constrained by price controls on the output side. Moreover, enterprises which make highly profitable copper products (like copper wire) can afford to pay higher prices for scrap than the smelter can. The chaotic market for copper scrap is perhaps the worst supply problem faced by the Shenyang Smelter in the short run.

2.21 Problems with energy supply have been exacerbated by the Shenyang Smelter's location and the multi-headed leadership system. But even without these added difficulties, since the smelter is a large energy consumer it would face problems in China's tightening energy environment. Its annual energy consumption is 210,000 tons of standard coal-equivalent (7,000 kcal per ton), which was over three ten thousandths of total primary commercial energy consumption in China in 1982, or about 0.4% of energy consumption in Liaoning Province.[13/] The smelter's share in the energy consumption of Shenyang Municipality must be quite substantial.

2.22 Though the Shenyang Smelter's unit energy consumption may be better than average in China,[14/] it falls well below international standards. Coal-equivalent consumption per ton of copper smelted, for example, is 900 kg, compared with only 400 kg at an advanced Japanese plant. Part of the differ-

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12/ This is a clear case of a Chinese enterprise being constrained by the need to at least break even in activities and transactions at the margin. This behavior is consistent with profit maximization, but it does not necessarily mean that the Shenyang Smelter or other Chinese enterprises actually maximize profits.

13/ State Statistical Bureau (1983, p. 250); Zhu (1983, p. 402).

14/ China's statistical yearbooks do not give national average figures for energy consumption in smelting of nonferrous metals, as they do for certain other industries. But the interviews conducted at the Shenyang Smelter indicate that a great deal of improvement has occurred and that in this respect as in others (like product quality) the smelter is considered an "advanced enterprise." Despite year-to-year fluctuations, unit consumption of electricity in copper and lead electrolysis fell considerably in 1975-1982, while electricity consumption in zinc electrolysis remained roughly constant (Statistical Appendix, item 36.)

ence may be due to use of backward techniques, part to smelting of lower-grade ores, and part to inefficiency in using existing techniques.

Multi-headed Leadership

2.23 As location can be considered the fundamental technical/physical constraint faced by the Shenyang Smelter, the multi-headed leadership system has been the critical organizational problem it suffered from in the 1970s and early 1980s, which was manifested in nearly all spheres of activity. The basic problem was that in different functional aspects, the plant "reported to" or was in important ways subject to different government organizations at central, provincial, and municipal levels. These organizations have different goals of their own, and there was little effort at coordination. As a result the smelter has been given inconsistent targets and directives, which not only made life more difficult but more important interfered with smooth operations and distorted incentives.

2.24 The multi-headed leadership system at the Shenyang Smelter was the direct result of the massive decentralization of industrial administration, government finance, and material supply that occurred in 1970-1971.[15/] Since numerous Chinese enterprises were transferred from higher to lower levels of Government at that time, the problems that the smelter faced were by no means unique. But because of the fact that it was transferred downward not once but twice (from the center to Liaoning Province in 1970 and to Shenyang Municipality in 1971) and due to its nationwide economic orientation in both supply and output distribution, the Shenyang Smelter's multi-headed leadership problem was most probably among the worst faced by any Chinese enterprise.[16/]

2.25 The original idea of the 1970-1971 decentralization was that control over all aspects of enterprise operations would be handed down to lower levels of government. But it was soon found that for enterprises like the Shenyang Smelter, local and even provincial authorities could not handle raw material supplies. Moreover, they often had little expertise about the technical side of production. Finally, these enterprises often produced key products which the central government wanted to continue to distribute in line with national priorities. As a result, central organizations (the Ministry of Metallurgy in the case of the Shenyang Smelter) continued to be responsible for allocation of the main raw material supplies. The fact that the Shenyang Smelter's sources of ores are scattered all over China made this arrangement all the more necessary. Given the close linkage between raw material allocations and output, the center also continued to set an annual production plan. In the case of the smelter, however, this central plan was just the amount of output that could be produced from the raw materials allocated centrally (based on technical input-output relationships).

15/ Among the best discussions of the 1970-1971 decentralizations is Xing (1983). See also Zhou (1984, pp. 134-147 and elsewhere).

16/ The Qingdao Forging Machinery Plant also faced a three-layer multi-headed leadership problem (provincial, municipal, county); see Chen Jiyuan et al (1984, pp. 75-79).

2.26 The situation with regard to enterprise finance was quite different. Local authorities generally had the capability to monitor the financial situation of enterprises and to collect taxes and profit remittances.[17/] The decentralization of government finances (which occurred in 1970-1971) gave provincial governments a strong incentive to increase revenues and therefore to accept responsibility for enterprises handed down to them in the financial sphere (at least profitable enterprises). Similar incentives probably also filtered down to the municipality and county levels.[18/] Since formal administrative jurisdiction over an enterprise generally carried with it the right to collect that enterprise's profits (virtually all of which were remitted to the government before 1978), this part of the decentralization tended to "stick." Transferring enterprises downward was relatively easy and welcomed by the recipients, while subsequent recentralization of formal jurisdiction and control over enterprise finances was very difficult and was resisted by the local authorities losing "their" plants.[19/]

2.27 In investment financing, the extent of decentralization appears to have been less than in enterprise administration, which means that large numbers of these decentralized enterprises must have continued to rely at least in part on central budget grants to finance investment projects. Central authorities were willing to make investments in enterprises not under their direct control because they could allocate the output generated, based on the principle that whichever government organization provided the investment funds had the right to allocate the resulting output.

2.28 Decentralization of authority over enterprises' labor force and hiring tended to gravitate to the lowest level of government, as in the case of enterprise finances. This was natural given the interest of municipalities

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17/ In the Chinese financial system, taxes and profit remittances are generally collected by local organs of public finance (Finance and Tax Bureaus), regardless of which level of government the revenues accrue to. Similarly, an enterprise's bank of account would not change when it was transferred from one level of government supervision to another. Even centrally-run enterprises have their accounts at the local bank branch, for obvious reasons of convenience.

18/ It appears that unlike after the 1980 fiscal decentralization, revenue sharing incentives were not passed down to the local (county or municipal) level in 1970-1971. But local governments may have had strong financial incentives to supervise as many enterprises as possible anyway, particularly because of the extrabudgetary revenues they provided, such as depreciation funds.

19/ Undoubtedly central ministries lost a considerable amount of authority and operational control in the 1970-1971 decentralization, but this was carried out as a national mass campaign in an intensely political atmosphere, which must have greatly weakened any possible resistance. The much slower pace of recentralization, carried out in an atmosphere of compromise and "voluntary" cooperation, provides an instructive contrast.

and counties in providing employment to new labor force entrants. For obvious reasons, localities would resist any transfer upward of control over labor allocation. However, local governments may well have played an important role in concrete hiring decisions regarding unskilled labor all along (even for centrally run enterprises in their localities). Moreover, total hiring by a locality was probably determined mainly by the supply of new entrants to the labor force rather than by local government discretion. In this situation, enterprises may have felt greatly restricted, but local authorities may not have been able to do much more than reshuffle a fixed total number of new workers among different enterprises.

2.29 Decentralization of authority to appoint and remove enterprise directors and Party Secretaries appears to have been uneven. In the case of the Shenyang Smelter, the Organization Department of the Central Committee of the Chinese Communist Party retained the right formally to approve changes in factory leadership. In other factories, the pattern has sometimes been quite different, with this authority devolved to the lowest level of government administration.[20/]

2.30 From the point of view of the Shenyang Smelter, three main problems resulting from the multi-headed leadership system can be singled out: (a) inconsistency between output targets (and corresponding raw material allocations) and profit targets; (b) the constant need to bypass the organization nominally in charge of the smelter (the Shenyang Municipal Metallurgy Bureau), which did not have the expertise or ability to help out in many areas but at the same time made many demands on the enterprise; and (c) a confused supply system with numerous gaps and involvement by three levels of government (central, provincial, and municipal) in allocating different materials.

2.31 The smelter had at least three different output plans and two different profit (and profit remittance) targets, most of which were mutually inconsistent. The Ministry of Metallurgy (MM) gave the factory output targets based primarily on the amount of raw materials it allocated to the plant through the central plan. The output target implied a certain level of profits (given other factors like material consumption rates, energy consumption, etc.). This appears not to have been given as a formal profit target to the enterprise, but it was easily calculated by MM and/or the Shenyang Smelter.

2.32 The Shenyang Metallurgy Bureau (SMB) gave the plant output and profit targets which were considerably higher than those set by MM and were not backed up by material supply allocations. Moreover, the profit and profit remittance targets given by SMB were excessively high even in relation to the output targets set by the same organization. For electrolytic copper, SMB output targets were generally more than twice as high as those assigned by

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20/ A good example is the Qingdao Forging Machinery Plant, whose leadership for a time continued to be appointed by local county authorities even after the factory was put under the supervision of Qingdao Municipality. See Chen Jiyuan et al (1984).

MM,[21] while for lead and zinc discrepancies (if any) were much smaller. In 1983, profit and profit remittance targets set by SMB were more than 30% higher than what the enterprise felt it could attain, based on past performance. The third set of output targets was the enterprise's own forecast of what it could actually produce, which was well above the targets given by MM but often below those set by SMB, and in any case below what would have been needed to fulfill the local profit target.

2.33 The reason for conflicting targets is very simple: the output targets set by MM were based primarily on balancing of centrally-controlled raw material supplies at the national level, while the profit target set by SMB was based on a total profit remittance target given to it by Shenyang Municipality, which in turn reflected revenue remittance targets set for the municipality by Liaoning Province. There was no reason for these targets to be consistent in the first place, and there appears to have been no built-in mechanism by which they were reconciled.

2.34 While this inconsistency between output and profit targets may have been present all along, it was probably to a large extent submerged when the Shenyang Smelter's actual profits were rising sharply in 1979 and 1980 and more or less stabilized in 1981 and 1982. Remittance targets in the public finance system have tended to increase more slowly than the growth of aggregate production and profits, particularly in 1980. On the other hand, they would still tend to increase even when for various reasons production and/or profits were falling. So the problem became very acute when profits fell drastically in 1983, as part of the conflict over recentralization of the factory. In other words, this particular aspect of the multi-headed leadership system became an especially severe problem for this enterprise only when attempts were being made to change the system.

2.35 One of the worst features of the multi-headed leadership system as it affected the smelter was the fact that it placed an organization without the necessary authority or technical expertise nominally in charge of the enterprise. The plant constantly had to bypass SMB and deal directly with MM on problems of production, supply, technical renovation, investment financing, etc. On the other hand, SMB had certain bureaucratic procedures which had to be followed by the enterprise even if it preferred to handle matters on its own.

2.36 Even worse, the local government made repeated demands on the Shenyang Smelter for resources of various kinds, for example requiring it to construct public facilities and even bus stations when it built apartment buildings for its workers. Though these kinds of "social responsibilities"

21/ In 1978, the copper output target set by MM was 22,000 tons, while that assigned by SMB was 50,000 tons. In 1979, MM's target was 25,000 tons, SMB's target still 50,000 tons. In item 33a of the Statistical Appendix some of the initial targets were assigned by MM (in years when planning management was so lax that SMB did not assign a physical output target for copper), while in other years it was set by SMB.

are a common problem for Chinese enterprises, the multi-headed leadership system may have aggravated them by giving local authorities a greater implicit claim on the smelter's resources.

2.37 Finally, SMB appears to have exploited the smelter by transferring supplies nominally (or in principle) allocated to the plant by higher levels to the smaller local factories also under its jurisdiction. This kind of favoritism may also partly explain the excessively high profit targets set for the factory. Given a total profit remittance target passed down to SMB from the Shenyang Finance Bureau, the former may have put an extra burden on the smelter in order to support its smaller enterprises which might have had more difficulty in meeting targets.[22/]

2.38 The complexities and contradictions of the multi-headed leadership system have been most obvious in material supply. It is therefore useful to provide a brief description of the Shenyang Smelter's material supply situation before 1984. The most serious problems were severe gaps in the supply of certain key inputs (aggravated by the multi-level planning system described above) and the allocation of different types of materials by different organizations and different levels of government, with little if any coordination.

2.39 Domestic and imported supplies of the three main ores (lead, copper, and zinc) as well as unrefined copper (blister) in principle were subject to unified allocation by MM.[23/] Suppliers are to a large extent fixed for multi-year periods. But there have been large gaps between allocated supplies and the smelter's production capacity for copper and lead. These are supposed to be covered by supplies obtained outside the central plan, from small local mines and, particularly in the case of copper, from recycling scrap. These outside-of-plan sources are abundant for lead, and indeed the plant appears to be offered more than it needs from local sources. For copper, however, resources from small mines are very limited (accounting for about 3% of total copper production in 1984), while scrap supplies are uncertain and increasingly subject to bidding wars (see p. 29 above). Nevertheless, even though shortages of the main raw materials may have been aggravated by the multi-headed leadership system, they have continued even when the system was changed in 1984, so their fundamental cause must lie elsewhere.

2.40 The Shenyang Smelter uses large amounts of coke, coal, fuel oil, and electricity. Allocations of coke and fuel oil are provided by MM, but there

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22/ This was the Shenyang Smelter's impression, but it would require a great deal more data (particularly information about the other factories under SMB) to determine whether this indeed occurred.

23/ Actually, though copper blister is imported by the state, it appears not to be included in the smelter's supply allocations from MM at the beginning of the year. Instead it may be used as a means of covering gaps that remain after the smelter has arranged as many supplies on its own as possible.

are gaps in both, and moreover contracts to supply coke often go unfulfilled. In the case of oil, the smelter relies on high-price purchases from Liaoning Province, barter of sulphuric acid for fuel oil with Liaoning Province, and purchase of oil skimmed from fields by peasants to make up the difference (total annual requirements of about 26,000 tons but a state allocation of only 20,000 tons). There are basically no outside-of-plan sources of supply for coke, so all the plant can do is press suppliers for more and rely on a good long-term relationship with the main suplier in Beijing.[24/]

2.41 The gap between coal requirements and the allocated quota is even more extreme: 40-45,000 tons are needed each year but the state allocation is only 20,000 tons. A considerable proportion of total coal usage, however, is for nonproductive purposes or for collective enterprises employing children of factory employees. Supplies within the quota are actually provided by the Liaoning Provincial Metallurgy Bureau (LMB), which probably also has a hand in determining quotas. The rest must be obtained from small or distant mines at higher prices and often much higher transportation costs.

2.42 Electricity supplies are allocated by the Liaoning Economic Commission (LEC), which adds still another important actor to the list of organizations with a crucial determining influence over the smelter's production level. Since there are no alternative sources of supply for electricity, the factory can only make repeated requests for extra supplies to LEC and power authorities (two staff members of the smelter are engaged full-time in this task). These requests can be effective in obtaining additional supplies, but there is a great deal of uncertainty day-to-day.

2.43 All in all, though problems with the supply of each kind of input can be attributed to specific factors and shortages, the multi-headed leadership system compounded them by adding organizational complexity. The large number of agencies at different levels of government responsible for allocation of important material inputs virtually invited conflicts and certainly had an adverse impact on the smelter's production and morale.

Shortage of Investment Funds

2.44 The Shenyang Smelter is plagued by old and deteriorating equipment, backward technology, and as a result, relatively high production costs and

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24/ One reason why coke supplies are short of requirements is that the Shenyang Smelter's allocation was not increased when a technical renovation project increased copper smelting capacity in 1982. Given the severe shortage of coke in China, new users and users with increased requirements tend not to be given additional supplies.

energy consumption.[25/] But in the late 1970s and early 1980s, the plant faced severe difficulties in obtaining funds for investment projects that it deemed necessary and profitable. Though average annual fixed investment almost tripled between 1975-1977 and 1980-1982 (see Table 3.1), this was considered far from sufficient in view of the need to renovate and modernize aging equipment and to invest in pollution control and energy conservation. Indeed, managers at the smelter cited shortage of funds as the binding constraint on their investment activities, as opposed to the availability of construction materials and equipment or even approval of investment projects by planning authorities.

2.45 A number of worthy projects suffered severely from the shortage of investment funds, even though they had received final approval from central government authorities. The most important example is a project for comprehensive utilization of slag from the lead smelter, a key technical improvement project approved by the State Economic Commission in November 1982. The approved project investment cost was Y 11.5 million, of which Y 3 million was to be financed by a state grant and the rest by bank loans. The state grant was to come in two allotments of Y 2 million and Y 1 million, from depreciation funds generated in Shenyang Municipality but remitted to the central government. Due to a policy change which allowed Shenyang Municipality to retain for its own use the depreciation funds previously remitted to the central government, the state grant (which was to come from these remitted depreciation funds) was effectively cancelled. Shenyang Municipality (which now had additional financial resources for investment) was supposed to cover the gap, but instead it appears to have allocated these funds for other purposes.

2.46 After a delay of as long as eight months, Shenyang Municipality gave the enterprise a "quota" to borrow Y 4 million from the local bank, but the latter at first refused to lend any money until grant funds were forthcoming as originally stipulated. Finally, the bank grudgingly provided an initial

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25/ Financial production costs at the smelter are high in relation to prices (and therefore costs) on international markets. The production cost of copper in 1981 was about Y 4,811 per metric ton, equivalent to US$1,718/ton at the exchange rate of Y 2.8 to US$1, or $2,813/ton at the then-current exchange rate of Y 1.71 to US$1 (Statistical Appendix, item 42). This compares with an international price of $1,743/ton in 1981 and considerably lower more recently. It would require a great deal of additional information to ascertain whether adjustments to derive the true economic cost of production would change this conclusion, but the factors which raise economic costs relative to financial costs may well be more important than those which lower them. The main downward adjustment would be to lower the economic cost of unskilled labor (the "shadow wage rate"); on the other hand, the cost of raw materials is probably below their economic cost, and that of energy certainly is. Moreover, financial costs do not include an adequate provision for capital costs, since capital has been provided in the form of grants and depreciation rates are low.

loan of Y 1.3 million in October 1983. The enterprise then started work on the project, spending Y 1 million on civil construction and Y 1.4 million for equipment. The equipment was still sitting in the warehouse as of late 1984; it was financed by short-term bank credit and treated as "receivables" in the smelter's working cpaital accounts.

2.47 Meanwhile, it was discovered that some complementary renovation work would be required in other parts of the lead production line, causing further delays in the project. There was also a conflict with the No. 3 Metallurgical Construction Company which had been assigned the project. In August 1983 the company made exorbitant demands for extra compensation for its construction workers, on the ground that they would be exposed to lead poisoning.[26/] The Shenyang Smelter refused to agree to this request, so work ground to a halt for a number of months. The costs of the delay were reported by the smelter to be Y 15,000 per day.

2.48 By late 1984 the conflict with the construction company reportedly had been resolved, and work was to be resumed shortly. Moreover, the Ministry of Metallurgy had verbally agreed to provide the Shenyang Smelter a grant of Y 2 million (through the Nonferrous Metals Industry General Corporation) and a loan quota for Y 3 million in 1985. But in the meantime the costs of construction and materials have gone up by 18%, and in any case sufficient funding for completing the project still has not been arranged. Though there were a number of specific problems affecting this project, their fundamental source was shortage of funds and conflicts over who should provide financing. It is particularly striking that the enterprise faced such severe funding problems and delays for a project which is in the state plan, appears to be fundamentally sound, and is expected to bring in additional profits of Y 3-4 million annually and greatly reduce environmental pollution.

2.49 Another project which has been adversely affected by the shortage of funds is enriched oxygen smelting in the copper blast furnace. For an estimated total investment cost of Y 8.3 million, the project would increase production of electrolytic copper by 3,100 tons and that of sulfuric acid by 25,000 tons, generating additional profits of more than Y 8 million annually. This project also was approved by the State Economic Commission; it was to be financed by Y 4.5 million in bank loans and Y 3.8 million from the plant's own funds. But only Y 1.3 million in loans had been provided as of late 1983, and there was no assurance that the rest of the money would be forthcoming. An oxygen generator purchased eight years earlier by the Shenyang Smelter is inefficient, has high energy consumption, and does not meet new noise standards. The generator should be traded in to the producer for upgrading at a cost of Y 2 million, but this has not been done due to the shortage of funds. Funding problems also appear to have delayed renovation and replace-

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26/ Specifically, the company demanded that an extra health insurance fee be paid (at the rate of Y 0.24 per worker per day) and that in addition workers receive one month's extra pay (for "vacation") every 4 months.

ment of some old lead sinterers, which smoke badly and adversely affect the health of workers.[27]

2.50 In addition to problems obtaining external financing, the Shenyang Smelter's internal financing sources are viewed as inadequate. The factory felt that the depreciation rate on its fixed assets (5.62%) was too low, in view of their age and the fact that 50% of depreciation funds must be turned over to government supervisory authorities (as is the case in most Chinese state enterprises). Moreover, the smelter must use some retained profits and depreciation funds to buy its assigned target of Y 700-800,000 worth of national Treasury Bonds each year (starting in 1981); and a stiff tax on retained profits and depreciation funds (first 10%, later 15%) was levied starting in 1983. More recently, a 10% tax on construction projects outside the state plan was imposed.

2.51 The shortage of funds for investment is in part a symptom of deeper underlying problems discussed earlier. It may be related to location: higher-level authorities may have decided that the smelter should not undertake major capacity-increasing investments because of pollution, the congested site, and other difficulties related to location. The lower priority apparently given to copper mining in plans for the future development of the nonferrous metals industry may also be relevant. The multi-headed leadership system undoubtedly plays a role, with different government agencies trying to avoid funding responsibilities, as occurred in the lead smelter slag utilization project. There are many organizational problems, as can be seen from the following passage from the interview report:

> Sources and channels of funds for technical measures in the plant are numerous. Some are small loans approved by central authorities; some are provided by the Ministry of Metallurgy; and some are provided by the Provincial Department of Metallurgy or the Municipal Metallurgy Bureau, or are provided by the enterprise itself. In principle, whoever provides the money exercises control, though statistical information is given to the Municipal Metallurgy Bureau. Many funds are decided upon without reference to the Municipal Metallurgy Bureau or the Provincial Department of Metallurgy, with the result that channels for these kinds of funds are fairly chaotic, there is no assurance of corresponding materials, and management is also chaotic. For example, some items are decided on by the State Economic Commission; however, since these are numerous (more than eight items), it cannot exercise control. The Provincial Department of Metallurgy and the Municipal Metallurgy Bureau do not exercise control, nor are they able to do so. They only figure in the disbursement of funds, but when it comes to procedures, actually no one is in charge.

27/ Reportedly the attendance rate of workers in the lead smelting system is only about 70%; it is not clear whether this is due to sickness or simply the poor working conditions.

2.52 Despite the undoubted severity of funding shortages, there is no evidence that the Shenyang Smelter diverted funds for workers' bonuses or welfare to productive investment. In fact, the plant overspent on collective welfare in 1982 and 1983, making up for this in part by underspending on productive investment.[28/] Thus its complaints about the shortage of investment funds must be seen in the context of an apparently overriding commitment to maintain workers' benefits in the face of falling profits.

Employment of Workers' Children

2.53 For an enterprise of the vintage of the Shenyang Smelter, finding employment opportunities for the children of workers is exceedingly important and difficult. Large numbers of workers who joined the factory in the 1950s had many children (since there was no strict family planning control at the time); these entered the labor force in the late 1970s or early 1980s. Moreover, expansion of the smelter's main production activities, a potential source of jobs for workers' children, was minimal after the mid-1970s. The magnitude of the problem can be seen from the number of children of workers placed in the factory or subordinate collective enterprises (most of them in the period after 1979). By 1982, the total number of workers' children employed reached close to 6,000, or about half of total employment. It is not known how many children of employees are still awaiting work assignments, but this may be a relatively small number.

2.54 The Shenyang Smelter's difficulties in finding employment for workers' children, though perhaps more extreme than in other enterprises, were typical particularly in the older industrialized base of Liaoning. But the problem impinged on the enterprise in the first place only because of the national policy measures devised to deal with employment problems in the late 1970s. Essentially, in many parts of the country, particularly in Northeast China, each enterprise was made responsible for finding employment for its own workers' children. This became the most onerous "social responsibility" of

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28/ Specified percentages of retained profits went into each of the following three funds: production development fund, workers' bonus fund, and workers' collective welfare fund. These percentages were set for the factory by higher levels but could be changed from year to year. In 1979-1983 the smelter overspent from its collective welfare fund by a total of Y 540,000 on a cumulative basis, while underspending on production development (Y 500,000) and bonuses (Y 340,000). Extra bonus funds were accumulated in part to pay for a wage adjustment (which was supposed to be partly paid out of the bonus fund) in 1983 and 1984. Running surpluses and deficits in the different funds does not require approval by higher level authorities, but they have to be reported in year-end statistics and carried over from year to year.

enterprises, though workers of course welcomed placement of children in jobs in the same factory.[29/]

2.55 The Shenyang Smelter and most factories in Northeast China responded to the employment problem in two ways: (a) hiring children as "collective workers" in positions alongside state workers (i.e. in the same workshop), and (b) creating collective enterprises subordinate to the factory, which could undertake various production and service activities. The former practice could breed perceived inequities and tensions among the workers; it was criticized by China's State Council, and attempts have since been made to "separate" state and collective workers. These have not been very successful, and over 2,000 collective workers remain in "mixed" positions in state-owned work units of the plant, compared with close to 3,000 such workers at the peak.

2.56 Two separate collective enterprises were established as divisions of the Shenyang Smelter in March 1979, one handling repairs and construction work, the other personal services for employees. They were combined into a "comprehensive services company" in 1981, then again split into two nominally collective enterprises at the beginning of 1982: the Repair and Construction Services Company (RCSC) and the Labor Services Company (LSC).

2.57 Both enterprises have been dependent on the parent factory for financial assistance and a guaranteed market; neither has been very successful in obtaining work outside the smelter. In 1982 outside work accounted for 37% of the revenues of LSC (but some of this may have represented sales to smelter employees), while virtually all of RCSC's work was for the parent factory. As of 1982, 62% of the fixed assets of RCSC and 21% of those of LSC were leased or rented from the Shenyang Smelter.[30/] More important, both collective enterprises owe considerable sums of money to the latter, which permits indefinite delays in payments (apparently financed as "receivables" in the smelter's financial accounts).

2.58 The situation may have been improved somewhat by measures to strengthen incentives for the collectives and make them more responsible for their economic performance, begun in 1984. But they apparently still remain a drag on the Shenyang Smelter's finances.

29/ Regulations allow that retiring workers (but not cadres) can be "replaced" by a child. However, many workers who joined in the 1950s had more than one child, and moreover timing problems often did not permit such replacements to occur. As of 1982, only 279 children of workers had "replaced" their parents in the Shenyang Smeltery.

30/ The rental rates may be very low, perhaps covering no more than depreciation on the equipment and facilities concerned.

III. RESPONSE TO PROBLEMS

3.01 This chapter will look at the various ways in which the Shenyang Smelter tried to deal with the problems described in Chapter II. The creation of a national nonferrous metals corporation and the consequent recentralization of administrative jurisdiction over the plant at the end of 1983 constituted a major response of the system as a whole rather than of the enterprise itself, so it will be discussed in detail in Chapter IV. The response to the problem of employing workers' children also was system-wide (region-wide in terms of the specific measures used) and has been described in Chapter II.

3.02 Some enterprise measures were directed at particular problems, but most had an impact in more than one area, and some even perversely exacerbated certain existing problems or created new ones. Some responses were relatively successful, while others resulted in only limited improvements or failed altogether, for various reasons. In particular, little if anything was done to ameliorate the problems caused by the smelter's poor location. Some responses were of a long-term nature and had been started more than a decade previously; others were devised and implemented only when problems became especially severe in the late 1970s or early 1980s. Some actions were factory-specific, while others (though undertaken by the factory itself) were related to national or regional policies.

3.03 We will start by looking at relatively narrow technical measures in the areas of production management, comprehensive utilization of ore byproducts, pollution control, and energy conservation. An apparently economically counterproductive response of quality improvement also will be examined. In many spheres of activity, an effective response required investment, so the Shenyang Smelter's efforts to obtain investment financing (which had mixed success) will receive attention. The plant's attempts to ensure that declining profits did not affect workers' wages and benefits also will be analyzed. As in the case of other Chinese factories, this occurred primarily in bargaining with supervisory agencies over financial flows and profit sharing. Direct marketing of certain products by the smelter and engaging in barter-type transactions were another response, usually on an ad hoc basis to deal with refusal by authorities to purchase certain products. Though the enterprise strongly desires to develop production of highly profitable alloys, this has not been possible so far, for reasons that will be discussed. Finally, the question of relocation, where no effective response at all was forthcoming, will be considered. The different measures taken by the plant will be evaluated individually in this chapter; a more comprehensive view of the Shenyang Smelter's actions and performance taken as a whole will be given in Chapter V.

Production Management and Constraints

3.04 In this area the Shenyang Smelter took relatively simple yet effective measures to ameliorate problems with the shortage of electricity, irregular supply of copper and lead ores, and a highly congested site with limited storage space. In arranging production over the short run, the

smelter basically lets production of zinc be the residual.[1/] This method was adopted for three reasons: (i) zinc production is relatively electricity-intensive, requiring 17 times as much power per ton as copper and 24 times as much as lead;[2/] (ii) prime processed zinc ore comes from only one nearby plant, and the smelter can ask the supplier to expedite or delay shipments as necessary; and (iii) copper and lead concentrate shipments to the plant cannot be regulated in this manner, and moreover they are highly irregular in the first place.

3.05 Concretely, the Shenyang Smelter gives first priority to smelting copper and lead ores as they arrive, diverting electricity supplies from zinc production if necessary. This allows it to minimize inventories, since shipments of zinc ore can be delayed if there is a production slowdown and copper and lead ore inventories are run down as quickly as possible after shipments arrive. Lower inventories mean less congestion and lower circulating capital costs. This method also ensures that if there is a shortage of electricity, the adverse impact on production and profits is minimized since only production of the most electricity-intensive product is affected.[3/]

3.06 This production management technique may seem elementary and obvious, and in any case it only ameliorated rather than solved any major problems. Nevertheless, it shows a certain degree of ingenuity which may be missing in many other enterprises. Moreover, it represents precisely the kind of incremental, marginal improvement that could generate substantial efficiency gains if applied by large numbers of enterprises in many spheres of activity.

3.07 Given the external environment faced by the Shenyang Smelter and the short-run optimizing measures it took, binding constraints preventing immediate increases in production are different for each of its main products. In copper smelting (producing blister from concentrated copper ore), the binding constraint most likely is capacity, which is intimately related to the inability to expand on the present site. However, any major expansion in capacity

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1/ This is one reason why zinc production generally shows greater fluctuations than production of lead or copper (see Statistical Appendix, item 4).

2/ Statistical Appendix, item 36. These figures are for 1982; there is considerable year-to-year variation, but in no year was the ratio less than 13.6 for copper or 18.8 for lead.

3/ In July 1983 the price of prime processed zinc ore was raised by Y 100/ton, without any increase in the price of electrolytic zinc. As a result profits on zinc production are very low, perhaps even negative. But the smelter strongly stated that its short-run production management approach was based primarily on the energy (electricity) situation, not different rates of profit for different products. Indeed, the smelter's use of this approach predates the price rise for zinc ore anyway.

might well run into a raw material constraint.[4/] In copper refining (transforming blister or scrap into pure copper), the binding constraint is clearly availability of raw materials. Capacity is 60,000 tons per year, production considerably lower (see Table 1.7). The binding constraint on zinc production is electricity, which as has already been seen is rational given its higher electricity intensity and the raw material supply situation. For lead production, the binding constraint is probably market demand. Prices are soft nationally, and the smelter is already in the position of being forced not to accept all the supply of concentrated lead ore made available to it (presumably because of weak demand for lead on the market).[5/] Finally, for sulfuric acid, the binding constraint was previously capacity, but it may now increasingly be the sulfur content of the ores the plant receives (over which it has no control).

Comprehensive Utilization of Byproducts

3.08 This has been a long-term response of the Shenyang Smelter to problems of pollution, limited capacity and raw material supplies, and financial constraints (since many of the byproducts are highly profitable). Recovery of rare metals from ores started as early as the 1950s; sulfuric acid production was developed in the early 1970s and greatly expanded thereafter; and it appears that there may have been a substantial increase in gold and silver production in the late 1970s (see pp. 19-20).

3.09 The most important impurity recovered is sulfur, which is common in most ores and is used to make sulfuric acid. Discussions on development of sulfuric acid production started in 1969, seemingly at the initiative of both the plant and higher-level authorities. Production was expected to be economically profitable and at the same time it would reduce sulfur pollution, for which heavy fines apparently were being introduced. The Ministry of Metallurgy and Liaoning Province provided grants for the needed investment. Facilities apparently were put in place very rapidly (which raises the question of why it couldn't have been done earlier), and actual production started in 1970. From the start production of sulfuric acid earned a profit, and the state price was used all along. By 1973 output was large and stable enough that it was included in the state plan; most was turned over to the State

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4/ The 1982 expansion of copper smelting capacity from 21,000 tons annually to 25,000 tons apparently was accomodated without major difficulties on the raw material side, though the supply of coke became problematic. This would suggest that some further expansion could occur without running into a raw material constraint. This would depend a great deal on China's investment program in copper mining and the expansion of other copper smelters or building of new ones.

5/ If the binding constraint were energy, the smelter would have an incentive to further shift production from zinc to lead, to the point where some other (nonenergy) constraint became binding. It is possible that capacity constraints or pollution considerations also may affect production of lead.

Material Supply Bureau for allocation, but some was under the control of Liaoning Province and some could be sold by the factory directly (see p. 56).

3.10 One interesting aspect of the sulfuric acid story is that it was successfully developed, apparently very rapidly, during the immediate aftermath of the Cultural Revolution. Another issue has already been alluded to: since sulfuric acid production is a near-universal activity of nonferrous metals smelters worldwide, the investment requirements in the case of the Shenyang Smelter apparently were manageable, and the gestation period was very short (only about a year, with profitable production possible immediately), why was it not developed in the 1950s rather than in the 1970s? There may be some reasonable explanation, since we do not know much about the enterprise's scale of production in the 1950s and 1960s or the types of ores used.[6/] But most likely the very late development of sulfuric acid production reflects a lack of profit orientation and insensitivity to pollution problems.

3.11 One other feature of the situation deserves mention: the smelter is forced to pay copper ore mines a fee of Y 50 for each ton of sulfur it recovers, which must substantially eat into its profits from sulfuric acid production.[7/] It even pays this charge for sulfur recovered from imported copper concentrate, though in this case it goes to the China Metals and Ores Import-Export Corporation. The fee was set by the Ministry of Metallurgy; since both mines and smelters were under the Ministry (now under the Nonferrous Metals General Corporation), all it does is redistribute income between mining and processing activities. This could be better accomplished by raising the price of ore, which would not harm incentives for smelters to recover sulfur.

3.12 There appear to have been more efforts to utilize byproducts and recover valuable metals from waste in recent years. The large investment project to recover lead and zinc from slag produced by the lead smelter is one example (see pp. 36-37). Intensified recovery of sulfur dioxide from flue gases and conversion to sulfuric acid is another. But these efforts may well be running into diminishing returns, as the easy and highly rewarding investment opportunities get used up. Thus though there may be continuing potential in this area in the future, the returns in terms of higher production, more profits, and decreased pollution will likely get smaller and smaller.

Pollution Control

3.13 The importance of pollution control work at the Shenyang Smelter in recent years is shown by its use of the slogan "using environmental protection to remain in existence, energy conservation to develop." A major commitment to reduce pollution was made only in 1978, however. Pollution caused by the

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6/ However, nearly all lead and copper ores occur as sulfides, meaning that sulfur inevitably will be released when they are smelted. See Muller-Ohlsen, (1981, pp. 41, 48).

7/ The price of sulfuric acid before November 1983 was Y 110/ton. At that time it was raised to Y 155/ton.

factory had worsened through 1977, though recovery of byproducts probably reduced certain kinds of pollution or even perhaps the overall level of pollution in relation to that of production.

3.14 The smelter's energetic program of pollution control that was started in 1978 included setting up an Environmental Protection Office under the leadership of the plant director (with a total of 160 personnel), establishing a monitoring network with penalties for noncompliance by workshops, and investing in a number of pollution control projects. In 1978 smokestacks were consolidated (and perhaps increased in height) to decrease local air pollution. In 1979 facilities to recover sulfuric acid from sulfur dioxide flue gases generated in copper smelting were completed; these cut the amount of sulfur dioxide gas discharged by more than half and permitted annual sulfuric acid output to increase from 60,000 tons to 127,000 tons. In 1980 water recycling was improved, cutting the amount of waste water discharged by two-thirds. In 1981 sulfuric acid was recovered from sulfur dioxide flue gases in the lead production system. Other pollution control projects are in the process of planning and construction.

3.15 All told, the Shenyang Smelter spent a total of Y 23.9 million on pollution control in 1978-1982, equivalent to 29% of its total fixed investment in that period.[8/] All but Y 2 million of this came from the plant's own resources. The lion's share (Y 16 million) consisted of profits derived from sulfuric acid production and ploughed back into reinvestment.[9/] The rest was from profits earned by utilizing byproducts and "returned fines" for pollution. The system of charges for pollution is a nationwide one designed to make them more palatable to polluters and to encourage investments in pollution control. Specifically, 80% of pollution fees levied are returned to the polluting enterprises, earmarked for use in pollution control projects.

3.16 Pollution control work in recent years by the smelter has been greatly aided by the fact that much of it is directly tied to recovery of economically valuable impurities in ores and byproducts of the smelting process. Thus most pollution control projects are financially profitable, which indicates that in the pre-reform period the plant must have paid little attention to profits as well as to environmental pollution, or at least that it had no voice in how investment resources were used.

8/ See Statistical Appendix, items 17 and 18; the share in productive fixed investment must have been considerably higher.

9/ It appears that at least some profits from sulfuric acid production could be retained by the smelter for use in pollution control investments, separate from the enterprise's normal profit retention scheme (see Statistical Appendix, item 18). This may have been a factory-specific special arrangement or a general policy applied to the nonferrous metals smelting industry. It predates profit retention schemes instituted as part of recent economic reforms.

Energy Conservation

3.17 A large part of the Shenyang Smelter's response in this area took the form of improved organization and management, which apparently had high pay-offs because energy management and energy consumption control in the past had been so lax. In 1979 an Energy Office was established; the number of staff has grown from 3 to 21. There are now also designated full-time energy personnel in each workshop, and (presumably part-time) energy workers and inspectors in work sections and teams. Norms have been established for energy consumption in production of major products, which are slightly tougher than those handed down by the Shenyang Municipal Metallurgy Bureau. With the passing down of energy consumption norms to the work unit and in some cases even to individuals, bonuses are now issued for superior performance in energy conservation. A considerable amount of work has been done to monitor energy consumption and heat balance, and to collect statistics. In 1980-1981, a plant-wide exercise in energy testing was conducted, and the smelter was certified by higher-level authorities as meeting standards.

3.18 The other main area of activity in energy conservation has been investments in various technical improvement projects designed to save energy. In 1981 a total of 30 such projects were started, including utilization of hot cooling water for heating in winter, better utilization of other waste heat, and use of cooling towers to recycle waste water. Between 1980 and 1982, a total of Y 4.5 million was spent on these kinds of projects, which resulted according to the enterprise's calculations in a saving of 10,000 tons of standard coal-equivalent.10/

3.19 Though considerable attention has been paid to energy conservation, investments appear to have been rather small compared with those in pollution control. A moderate downward trend is apparent in certain indices of unit energy consumption, though there are great year-to-year fluctuations. For example, electricity consumption per unit of electrolytic copper produced dropped by 14% from 1975 to 1982, but the 1981 figure was slightly higher even than those in 1975-1977. The corresponding index for lead showed a more steady decline. Unit consumption of heavy oil in lead and zinc smelting showed little tendency to decline.11/ Unit total energy consumption rose

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10/ Assuming a cost of Y 50/ton for standard coal (which is somewhat above the official state price including transportation but much below some prices observed on the open market), the profits generated by these projects would total about Y 500,000 per year, implying a financial rate of return of over 10%. Though respectable (particularly considering the artificially low price of coal in China) this is much below the returns on pollution control projects discussed earlier. However, some of these projects may have other benefits in addition to energy conservation.

11/ Statistical Appendix, items 36 and 38. It is most probable but not specified that the electricity consumption figures are for electrolysis alone (not including electricity used in earlier stages of the production process).

somewhat in the first eight months of 1983, but this was apparently due entirely to factors beyond the smelter's control. These included an increase in the share of concentrated ore (as opposed to unrefined copper) in total raw material supplies; adulterated raw materials which required longer smelting; interruption of production due to the shortage of supplies at times; and (increased) use of energy by collective units subordinate to the smelter (see pp. 84-85 for a more detailed discussion).

3.20 This list provides some indication of the difficulty of pursuing energy conservation once some obvious opportunities have been exploited and the worst forms of waste eliminated. Further improvements probably require more substantial investments and therefore may be hindered by the Shenyang Smelter's shortage of funds and also by the generally low financial returns on energy conservation. Finally, the nature of the production process in nonferrous metals smelting is inherently energy-intensive, so if energy conservation in the Shenyang area or in Liaoning Province is deemed to be of very high priority, the option of shutting down the plant and relocating operations elsewhere or relying more on imports of pure metals would be more attractive than additional costly investments at the present site.

Quality Improvement

3.21 For the main products of the Shenyang Smelter, purity is used as the primary indicator of quality. Measured by this standard, the smelter produces output of exceptionally high quality. It won a gold medal for electrolytic lead in 1980 and a silver medal for electrolytic copper in 1984.[12/] In addition, five other products have been certified as high-quality products by the Ministry of Metallurgy.

3.22 Quality control work is under the overall leadership of a Quality Control Committee, headed by the plant director and including all workshop heads and several other top managers. Implementation and inspection is handled by a Quality Control Section and a Technical Inspection Station; there are also quality control teams in each workshop. If quality is not up to standard, bonuses for the workshop responsible can be cut. In addition to internal quality control, there are random quality checks by the Shenyang Municipal Bureau of Standards and (before 1984) by the Shenyang Metallurgy Bureau.

3.23 One-time bonuses can be awarded to the entire work force when the enterprise wins a national quality prize. [In 1980 the bonus was Y 60 per worker, in 1984 Y 20.] Since these bonuses can be drawn from production costs, they at least allow retained profits that otherwise would have to be

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12/ These are medals awarded by the state for high-quality products. A gold medal is awarded when a Chinese factory meets advanced international standards, a silver medal is for top quality by domestic standards, and a bronze medal for slightly lower quality. The Shenyang Smelter was the only enterprise to win a gold medal for lead in 1980, while three other factories also got silver medals for copper in 1984.

used for bonuses to be diverted to workers' welfare or productive investment.[13/] Other than this, the main benefit from winning prizes for quality or more generally for maintaining high-quality output appears to be a better reputation for the firm and its products. In the case of the smelter this probably did not have much of an impact on sales, since its products have been in short supply anyway. However, a good reputation for quality may have helped the plant when important decisions were being made by higher-level authorities about possible shutdown, relocation, or even recentralization.

3.24 There is some evidence that the Shenyang Smelter's concern for quality goes well beyond the needs of customers. In the case of electrolytic copper, the national standard for top grade in quality is 99.95% purity. This is more than sufficient for the needs of nearly all users. But the smelter does even better than this, sometimes reaching 99.97% or 99.98%. Due to fluctuations in quality it may be necessary to produce at above 99.95% in order to ensure that this standard is always met, but the desire to win a quality prize and gain a good reputation may be a more important motivation.

3.25 In the case of zinc, quality also exceeds customer needs, but the reason is strictly financial. Using the smelter's technology, the production cost for zinc of different grades is very nearly the same, but the price is different: Y 1,930/ton for 1st grade, Y 1,900/ton for 2nd grade, and Y 1,850/ton for 3rd grade. Customers prefer 2nd or 3rd grade zinc; but the smelter's output plans and supply contracts only call for "1st or 2nd grade zinc," and it always produces the former.[14/] Several years ago, it was specified that the factory should supply 70% 1st grade zinc and 30% 2nd grade zinc, but this rule no longer applies.

3.26 Thus the Shenyang Smelter's focus on quality control and its success in improving quality appear to be at least in part dysfunctional from a national economic viewpoint. How much extra it costs the plant to maintain excessively high quality and the pay-off from reducing quality somewhat cannot be determined without detailed further study. But if much of the extra cost is in the form of unrewarded additional effort by workers and managers, it may be worthwhile to hold onto very high quality standards as a means of improving the organization of production and even instilling pride and discipline in the labor force.

13/ The smelter claimed that these bonuses could not result in an increase in the total amount of bonuses paid to workers, but in 1980 control over bonuses was very lax anyway, and in 1984 ceilings on bonuses were being replaced by a bonus tax for bonuses above a certain level (specified in terms of months' average basic wages per worker).

14/ This is a very concrete example of how weakening control over product mix in a situation of chronic shortage hurts the interests of users. Montias (1977) has shown that in general, aggregation of targets (rather than specifying targets for each variety) will result in an inferior composition of output from the viewpoint of central planners.

Investment Financing

3.27 As has been seen in Chapter II, the Shenyang Smelter perceives a severe shortage of investment funds, both in aggregate and for individual projects. It appears that availability of funds rather than bottlenecks in the supply of building materials or other investment goods is the key constraint hindering investment activity. Nevertheless, it must be kept in mind that investment at the smelter has not been insignificant in recent years. In 1978-1982 total fixed investment by the plant, not including subordinate collective enterprises, was Y 103.32 million (see Table 3.1). Investment in circulating capital during the same period (the net increase in quota circulating assets from the end of 1977 to the end of 1982) was Y 12.55 million (Statistical Appendix, item 14). Total investment was therefore Y 115.37 million, equivalent to 53% of total administrative profits earned in 1978-1982, or 63% of total capital at the end of 1982.[15/] This is quite a respectable reinvestment rate in an aging, highly profitable enterprise like the Shenyang Smelter, and undoubtedly is higher than in many other Chinese enterprises. It may well be that problems with a shortage of investment funds became acute only when attempts were being made to recentralize jurisdiction over the smelter. This would be only natural if government agencies allocating investment resources were not certain about who would eventually have administrative control over the enterprise.

3.28 Looked at in another light, the smelter's complaints about shortages of investment funds appear more reasonable. If investment financed by depreciation and major repair funds is subtracted from the total, the ratio of "net" investment to profits becomes only 18%, which indicates that relatively little new investment money was flowing in.[16/] Moreover, the plant is allowed to retain only 50% of total depreciation charges on its fixed assets, and some retained depreciation funds appear to be diverted to purposes other than fixed investment. This means that there is probably a substantial shortfall in replacement investment as well as a lack of new investment.[17/] Rising investment costs in recent years most likely have exacerbated this problem.

15/ Statistical Appendix, items 14, 17, 18, and 27. Total capital is equal to net (depreciated) fixed assets plus quota circulating assets. Since the investment figure includes investments financed with retained depreciation funds, the reinvestment rate from profits is somewhat overstated.

16/ A large share of enterprise retained profits has been used for consumption rather than investment (workers' bonuses and certain forms of collective welfare). In principle, the smelter could have spent at least some of this money on investment, upping the reinvestment rate.

17/ Both of these gaps may be appropriate if it is deemed better for the smelter to eventually close down. But if this is the case, it might have been better to prevent the plant from investing as much as it did in recent years.

3.29 The financing of the Shenyang Smelter's fixed investment is shown in Table 3.1. Contrary to the situation in many other factories, the sources of investment finance were not too different in the pre-reform and post-reform periods. In particular, reliance on bank loans and on local government grants has been minimal all along. Depreciation and major repair funds have been the mainstay, and profits from sulfuric acid production earmarked for pollution control investment and pollution fees returned to the factory have become increasingly important. State grants have been relatively small all along, accounting for less than 16% of total fixed investment in 1975-1977 and less than 8% in 1978-1982.

3.30 Except for the earmarking of profits from sulfuric acid production for investment in pollution control, the use of returned pollution fees for the same purpose, and an increase in the depreciation rate from 5.62% to 6.62% in 1984 (all of which may be national policy measures rather than factory-specific), the Shenyang Smelter has not been very successful in tapping new sources of investment funds. This may reflect low priority attached to investment in the smelter by higher-level authorities or lack of receptivity to innovative practices (like mergers and associations) on their part.[18/] The enterprise may also be hindered by lack of control over the marketing of the vast bulk of its products, which might have been a strong bargaining chip in obtaining funds.

3.31 But there is also a more fundamental question which must be posed: Should the Shenyang Smelter spend more on investment in renovating and modernizing facilities at its present site, of if shutting down the facility is the best option, is even the present level of investment spending too high? This is closely linked to the location issue (see pp. 24-26) and to the related pollution problem; a strong case can be made that in the interst of long-term improvements in efficiency it is entirely appropriate that the smelter not be permitted to spend all it would like to on investment. In this situation, it would be only natural for the enterprise to perceive a severe shortage of investment funds.

Manipulation of the Financial Incentive System

3.32 The history of profit-sharing schemes at the Shenyang Smelter is unexceptional, conforming to the broad trends followed by Chinese state-owned industry as a whole. In 1978 the "enterprise fund" scheme was restored after a lapse of more than a decade; the plant retained the equivalent of 5% of its total wage bill (but drawn from profits), which was used for collective welfare expenses. In 1979 the enterprise was put under the national pilot program of enterprise-level reform and was allowed to retain 5.74% of within-quota profits and 10% of above-quota profits. Retained profits were to be used in specified proportions for productive investment (the "production development" fund), collective welfare, and workers' bonuses. In 1980 the above-quota retention rate was raised to 20%, but there were no other changes

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18/ Other hindrances to mergers and associations have already been discussed on pp. 24-25.

Table 3.1: SOURCES OF INVESTMENT FINANCING, 1975-1982 /a
(Y million and share of total - %)

	1975-1977		1978		1979		1980		1981		1982		1978-1982	
	Amount	Share	Amount	Share	Amount	Share	Amount	Share	Amount	Share	Amount	Share	Amount	Share
State grants	4.28	15.6	-	-	3.60	24.3	2.81	11.2	1.70	6.1	-	-	8.11	7.8
Local government grants	-	-	-	-	-	-	-	-	-	-	0.50	1.9	0.50	0.5
Retained profits	-	-	-	-	-	-	0.82	3.3	3.29/b	11.8	4.61	17.8	8.72	8.4
Basic depreciation funds	12.57	45.8	5.60	58.6	3.25	21.9	11.68	46.6	10.90/b	39.0	7.74	29.9	39.17	37.9
Major repair funds	8.77	32.0	3.96	41.4	4.92	33.2	4.96	19.8	7.69	27.5	4.41	17.0	25.94	25.1
Pollution control funds /c	1.80	6.6	-	-	3.07	20.7	4.80	19.1	3.93	14.1	7.43	28.7	19.23	18.6
Bank loans /d	-	-	-	-	-	-	-	-	0.45	1.6	1.20	4.6	1.65	1.6
Total Fixed Investment	27.42	100.0	9.56	100.0	14.84	100.0	25.07	100.0	27.96	100.0	25.89	100.0	103.32	100.0

/a Total fixed investment by source of financing, including both capital construction investment and modernization investment.

/b Assumes that half of the Y 1.5 million in capital construction investment financed by "self-raised funds" in 1981 consisted of retained profits, the other half basic depreciation funds.

/c Profits from sulfuric acid production earmarked for use in pollution control projects, plus 80% of pollution charges levied on the smelter, also earmarked for investment in pollution control.

/d All from the People's Construction Bank of China.

Source: Statistical Appendix, items 17, 18.

in 1980 or 1981. During this period profit quotas appear to have been substantially raised in line with the sharp increase in realized profits (see Table 3.2), so as a result there was little change in the average profit retention rate between 1979 and 1981.[19]

3.33 In 1982 the system was changed to one under which the smelter retained none of within-quota profits but 40% of above-quota profits. The profit quota was reduced so that the average profit retention rate turned out to be slightly higher than in 1981. In 1983 the plant was put under the nationwide profit tax system; it had to pay a 55% profit tax and a 36.2% "adjustment tax", which allowed it to retain 8.8% of total profits (with no distinction between within-quota and above-quota profits).[20] As can be seen from Table 3.2, the amount of retained profits increased in 1979 and 1980 (after starting at a very low level in 1978), and then fell moderately in 1981-1983.

3.34 As in the case of other Chinese state-owned industrial enterprises, a "soft" financial incentive system has cushioned the impact of declining profits on the Shenyang Smelter's retained profits and workers' living standards. Total profits dropped by more than 40% in 1983 but retained profits fell by only 16%; as a result the share of profits retained by the enterprise increased from 7.7% in 1982 to 11.2% in 1983 (Table 3.2). Bonuses were not much affected by the decline in profits or the shift to the profit tax system, contrary to the smelter's initial fears.

3.35 In 1984 a sharp price rise for sulfuric acid helped boost profits. The scheme whereby the plant was allowed to retain a substantial proportion of profits earned from sulfuric acid production (separately from the regular profit-sharing system) for use in pollution control investments may have involved special consideration not accorded to other smelters or sulfuric acid

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19/ It is clear from Table 3.2 and items 31-32 in the Statistical Appendix that the profit quotas used in the Shenyang Smelter's profit retention scheme have no discernible relationship to plan targets for total profits or for profit remittances to the government.

20/ It appears that either the smelter was allowed in 1983 to retain more profits than it was formally entitled to or that there actually was provision for a higher retention rate from above-quota profits (as was common in other enterprises). Dividing actual 1983 retained profits by 8.8% yields Y 37.2 million, considerably more than actual 1983 profits of Y 29.2 million. It is possible that the plant was permitted to retain profits in accordance with its revised profit target of Y 35.2 million rather than actual profits.

Table 3.2: PROFIT SHARING, 1978-1983
(Y million)

	Total profits /a	Retained profits	Implied profit quota /b	Share of profits retained (%)
1978	18.76	0.28	-	1.5
1979	43.05	3.0	30.6	7.0
1980	53.32	4.28	44.8	8.0
1981	54.16	3.91	48.5	7.2
1982	50.35	3.90	40.6	7.7
1983	29.20	3.27	- /c	11.2

/a This is "administrative profit" (item 26 in the Statistical Appendix), which is profits from commodity sales net of profits and losses on non-business activities.

/b This was derived by taking within-quota and above-quota profit retention rates given by the smelter for each year and calculating what the quota should be, given actual total profits and retained profits. Since the total profit figure used in determining the amount of retained profits sometimes differs from actual profits, these estimates are subject to error.

/c The 1983 profit retention rate was given as 8.8%. But actual retained profits were 11.2% of total profits, which means that either the smelter was given special consideration in 1983 or there was a provision for retention at a higher rate from above-quota profits.

producers.[21] The smelter was also allowed to finance a long-term loan to the Benxi County Cement Plant through its circulating capital accounts.[22]

3.36 In 1983 the Shenyang Smelter gained substantial benefits from its designation as an "experimental unit" in wage reform. This permitted it to raise wages by an average of Y 1.5 per worker per month, above and beyond the Y 7 per worker per month wage readjustment that occurred at the same time. The extra money was used to simplify a complicated and inequitable wage grade system while ensuring that no workers suffered wage reductions in the process. In addition, wages of certain deserving employees like intellectuals and workers in the lead production system were raised by one half grade. Large wage increases in 1983 prevented any worker discontent due to a slight reduction in bonuses.[23]

3.37 Despite these machinations, compared to many other Chinese enterprises the Shenyang Smelter appears not to have been especially active or successful in manipulation of the incentive system. For example, there was no great increase in the average profit retention rate in 1981 or 1982, a time

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21/ Based on very rough estimates, total sufuric acid production in 1978-1982 was about 500,000 tons. At the state price of Y 110/ton, this was worth Y 55 million, of which Y 16 million was used for pollution control investments. This was about 30% of total sales revenues and probably a considerably higher share of profits. It is not clear whether this scheme was factory-specific or nationwide.

22/ This loan, part of a compensation trade deal, was for Y 1.7 million interest free, with a maturity of 15 years (repayable in equal yearly installments). In return, the Benxi County Cement Plant agreed to provide the smelter with 10,000 tons of cement per year, at the Liaoning Provincial administratively-set price of Y 92/ton. Another part of the deal was that the Shenyang Smelter converted an old rotary kiln used in zinc production into a cement kiln and provided it to the cement plan (apparently free of charge). The loan was carried in the smelter's accounts as part of "receivables". It is not clear whether the bank knew of or agreed with this practice. The Chongqing Clock and Watch Company used a similar method to advance money to one of its associated enterprises; this was at least tacitly approved by the bank, though it charged a penalty interest rate. Moreover, that advance was at least in principle a short-term loan. See Byrd and Tidrick, (1984, p. 48).

23/ Total bonuses drawn from retained profits (the so-called "comprehensive bonus") fell by about 12% in 1983 (from Y 1.354 million in 1982 to Y 1.19 million), which was far less than the proportional decline in total profits or in total retained profits. Based on the average number of employees in 1982, the reduction in bonuses averaged about Y 24 per worker. On the other hand, the increase in wages (not counting certain special measures) averaged over Y 100 per worker. Moreover, special bonuses drawn from production costs jumped by 86% in 1982 and may have further increased in 1983.

when other enterprises were taking advantage of the campaign to promote "economic responsibility systems" to sharply increase their retained profits. The smelter also had great difficulties in getting its profit target reduced in 1983, when there were valid reasons for expecting lower profits, and in the end the increase in the actual profit retention rate was relatively modest. The plant's inability to manipulate the incentive system more than it did probably was due to its awkward position in relation to both the Ministry of Metallurgy and Shenyang Municipality; its requests may not have been supported by either the latter (which felt it was losing its stake in the enterprise) or the former (which may not have had much ability to give the smelter "special treatment" under the circumstances). This lack of a suitable "patron" at local or central level may also partly account for the severity of some of the other problems faced by the plant. In any case, this shortcoming would have been especially acute during the period of uncertainty about recentralization.

Direct Marketing and Tied Transactions

3.38 To a large extent this has been a passive response by the Shenyang Smelter to refusal on the part of material supply authorities to purchase certain byproducts and, more rarely, part of the output of its main products. Direct marketing by the enterprise predates the economic reforms of the late 1970s and is largely unrelated to them. Four main types of sales outside the state plan can be distinguished: (1) material supply authorities force the plant itself to market certain byproducts which are in excess supply nationally; (2) enterprise sales of sulfuric acid are an important exception to the general pattern; (3) mines which supply ores to the smelter outside the central plan often demand that the resulting output of metal should be sold back to their localities, and the same type of "processing" arrangement may apply when the factory purchases scrap for recycling; and (4) as a result of the sharp cutback in investment in early 1981, some units with assigned allocations of copper cancelled their purchase contracts, leaving the smelter with inventories to get rid of. Each of these will be discussed in turn.

3.39 One of the most telling complaints of plant management is that the enterprise is forced to market on its own goods that are in excess supply, while material supply authorities insist on distributing all production of goods in short supply. This practice may have certain benefits where producers are able to respond to market demand, but smelters have little if any ability to change the output of most byproducts. Reducing production would exacerbate pollution, and maximum output is determined by the mineral composition of the raw materials shipped in. The Shenyang Smelter is therefore in the unenviable position of being responsible for selling goods whose production it has no control over.

3.40 Cadmium is a good example. It was previously used in making plastic sheeting for agricultural use, but this resulted in food contamination and was discontinued. Inventories accumulated, and the smelter was made responsible for marketing. The market price tumbled to less than Y 10,000/ton, compared with the official price of Y 19,000/ton. Even so, the only way the plant was able to get rid of inventories was by tying sales of cadmium to some sales of zinc to within-plan customers. Specifically, since cadmium is a byproduct of zinc smelting (at 5-8% of zinc output), the smelter got approval from the

State Material Supply Bureau to tie sales at the rate of one ton of cadmium to ten tons of zinc, a practice which applied to 12% of total zinc output.

3.41 Other examples of goods in excess supply that the enterprise is forced to market itself are indium and palladium. One exception to the general pattern appears to be platinum, which has brisk sales but is marketed directly by the plant. Also, starting in 1980 certain Category II products previously allocated by the Ministry of Metallurgy were directly marketed by the smelter, including copper sulfate, nickel sulfate, and zinc oxide. As far as the plant is concerned, it would prefer to have no "self-sales" at all of any of these products.

3.42 On the other hand, the Shenyang Smelter gains considerable benefits from self-sales of sulfuric acid, which until recently was in short supply. All along, some output (about 25-30%) has been subject to provincial allocation and some (5-10%) has been under the control of the plant itself. Since 1980 the unwritten but apparently quite stable arrangement has been as follows: The annual state plan is fixed at 80,000 tons, all of which is allocated by the State Material Supply Bureau. Liaoning Province gets 20-30,000 tons, while the smelter gets about 5,000 tons for its own use and in addition can sell 5-10,000 tons directly. In 1983 it entered into a tied transaction with the Anshan Iron and Steel Company, whereby it sold 2,100 tons of sulfuric acid to Anshan and in return was allowed to purchase 700 tons of rolled steel it needed. Some of the sulfuric acid earmarked for the plant's own use is actually exchanged with rural areas for rice for smelter employees, while some of the self-sales portion is sold on the basis of outside-of-plan requests by higher-level authorities and other units. But most important, the sale of sulfuric acid to Liaoning Province is informally tied to the plant's purchase of 3,000 tons of fuel oil per year from the province at the state price. [All sales of sulfuric acid also are at the state price.] This goes a long way toward alleviating the chronic shortage of oil (see p. 35).

3.43 Direct marketing of the above products is not insignificant; it amounted to Y 9.23 million in 1978, before nationwide policy promoted self-sales. In 1982 the figure reached Y 12.37 million, indicating that reforms had no significant effect in increasing direct marketing of this type. The share of these types of self-sales in total sales has been very small all along, less than 2% in 1978 and only slightly more than 2% in 1982.

3.44 There is some confusion and apparent contradictions concerning the Shenyang Smelter's direct marketing of copper, lead, and zinc. According to one account, there is no direct marketing of zinc by the plant (the sales tied to cadmium sales are to users designated in the central plan). But at a different meeting it was stated that at least until 1983, zinc recovered in the recycling of scrap lead could be directly marketed by the factory. Similarly, at one point it was stated that self-sales of lead account for no more than about 7% of total output, consisting of above-plan supplies from ore mines and recycling of scrap. Since lead is now readily available on the market, very little is sold back to mining areas in tied transactions. But a different representative of the smelter asserted that there were no self-sales of lead.

3.45 Comments on direct marketing of copper show the most serious conflicts, however. According to one account, no more than about 5,000 tons of copper is produced from concentrate supplies obtained from domestic mines outside the central plan, and only about 3,000 tons of this is marketed directly by the smelter (the rest is sold back to producing areas on a tied basis). This amounts to only about 7% of total output, but in addition a certain proportion of copper recycled from scrap (which in total accounted for 30% of copper output in 1983 and 1984) also was presumably directly marketed. Until 1983, the factory reportedly had the right to market all copper produced from scrap it purchased on its own.[24/] At a later point in discussions it was denied that any significant direct marketing of copper had ever occurred. Self-sales controlled by the smelter were stated to be minuscule, no more than 250 tons per year. Nearly all copper produced from above-plan supplies of ore was "returned" to the mining areas, and copper recycled from scrap was either returned to suppliers of scrap or allocated by higher-level authorities.

3.46 At least part of the discrepancy between these accounts may be explained by the significant role of the Shenyang Smelter's provincial-level supervisory agency (now the Shenyang Nonferrous Metals Corporation, previously Liaoning Metallurgical authorities) in arranging transactions with small local ore mines and possibly also scrap suppliers. The resulting output and sales to a large extent may not have been subject to unified allocation by the State Material Supply Bureau, but at the same time they may have been largely tied or subject to allocation by provincial authorities and so not really under the plant's control. But a reliable understanding of the actual situation regarding direct marketing of copper (which is a scarce commodity in China) would require further inquiry.

3.47 As a result of the sharp but temporary drop in demand for copper in 1981, some enterprises which had already been allocated copper from the smelter under the central plan (and had actually signed supply contracts) had production and investment targets sharply reduced and some of their funds in bank accounts frozen. As a result they were unable to fulfill their contracts, leaving the smelter with rising unsold inventories, which reached 2,000 tons by May 1981. The plant requested the State Material Supply Bureau and State Economic Commission to deal with the problem. In the end the Northeast Procurement Station of the State Material Supply Bureau did purchase the excess inventories, some on credit. By July 1981 the problem reportedly

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24/ In a 1983 State Council document it was specified that only 30% of above-plan production of copper could be sold directly by producers, but it is not clear whether and to what extent this ruling was enforced in the case of the Shenyang Smelter. In any case, the increasing scarcity of scrap and price controls on copper (even allowing a 20% higher floating price for production outside the plan starting in 1984) mean that suppliers are now generally unwilling to provide scrap unless they get finished output in return.

was solved, though it apparently generated continuing conflicts over self-sales of copper during the next several years.[25/]

3.48 Despite the confusion and contradictions, a number of common themes emerge concerning direct marketing. Except in the case of sulfuric acid, the Shenyang Smelter is not interested in direct marketing and appears not to gain any major benefits from the self-sales it does undertake. In fact, it would greatly prefer unified central allocation of all products over the present hybrid situation. This is undoubtedly related to the fact that price controls have been stringent even for directly marketed output. But even more important has been the common pattern of the plant being forced to sell on its own items in excess supply and by and large not being permitted to market directly goods in short supply. In any case, it is doubtful whether more direct marketing would encourage the enterprise to do much more in the way of developing new products, improving quality (which may already be too high), reducing costs, or otherwise better serving customer needs. This is due in part to the nature of the smelter's products and production process, in part to the fact that it has already achieved high quality standards in the absence of direct marketing, and in part to the fact that copper and zinc are in short supply anyway so sales are assured. Finally, direct marketing of goods in short supply to a large extent may take the form of tied transactions with suppliers of raw materials (which inevitably also are in very short supply) or possibly of sales informally controlled by immediate supervisory organizations. All in all, the role and benefits of direct marketing have been quite different from what has occurred in the case of differentiated products in excess supply.[26/]

Development of Alloy Production

3.49 The last two enterprise responses discussed in this chapter have been basically unsuccessful. Nevertheless, it is instructive to examine the reasons for failure, which differ in each case. Both in alloy production and in relocation, lack of success is due mainly to factors beyond the smelter's control.

3.50 The Shenyang Smelter would much prefer to produce alloys rather than pure metals, because the former are overpriced relative to the latter and therefore production is highly profitable compared with smelting of pure metals. Production of alloys would therefore help ease the plant's financial constraints. Alloy production might also allow the smelter to take over

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25/ Reportedly, in the difficult situation of 1981 the director of the State Material Supply Bureau gave oral instructions that the smelter could market excess inventories of copper directly, and these instructions were never formally rescinded. But they appear never to have been fully implemented, either.

26/ The Chongqing Clock and Watch Company and the Qingdao Forging Machinery Plant are both good examples of the latter. See Byrd and Tidrick (1984) and Chen et al (1984).

lucrative business now handled very inefficiently by small urban and rural collective enterprises (for example in the production of lead alloys for typesetting, which is being done by 400-500 collectives and individual households in Shenyang Municipality alone).

3.51 At present the smelter is required to provide the State Material Supply Bureau with pure metals, which many users then have to resmelt into alloys that they require for their production activities. The quality and durability of alloys produced by users reportedly is sometimes poor. For instance, underwater cables produced in China last only three or four years because of poor alloy quality, compared to 20-30 years in other countries. Finally, since smelting is a process of purification and alloy production reintroduces certain impurities in fixed amounts (some of which may have been present in the original ores), separating the two activities generally increases costs, energy consumption, and pollution. In other countries, most nonferrous metals smelters are also involved in alloy production (over three-quarters of those in the United States, for example), but in China this is not the case and no government organization is responsible for developing alloy production.

3.52 The Shenyang Smelter argues convincingly that it is better equipped than most users to produce high-quality alloys and could do so at lower cost because it could operate on a larger scale. Users and their ministries, however, would oppose such a change since it would erode lucrative profits and employment provided by alloy production. It is also possible that users feel they could not rely on outside suppliers for timely shipments of alloys of the right specifications.[27/] Thus production of alloys on a large scale by the smelter could only happen with the approval of central authorities, which would have to impose such a solution on users.[28/] So far this has not happened, and the plant only produces small amounts of alloys on an experimental basis, using materials obtained outside the plan. It was preparing to produce several thousand tons of alloys in 1984, however.

27/ The importance of responsiveness to specific user needs as a factor influencing the location pattern of the world nonferrous metals smelting industry has already been mentioned (see p. 6). In China the need for customized alloys and the general lack of responsiveness on the part of suppliers to users' needs in a chronic shortage situation may have virtually dictated backward integration by users into alloy production.

28/ The smelter believes that it could not compete effectively with users in production of alloys if it is forced to rely on raw materials obtained outside the plan, since these are more costly and users at present get allocations of pure metals through the plan at the state price. Thus as far as the plant is concerned the only solution is to force users to accept delivery of alloys rather than pure metals; there could presumably be some room for negotiation about price, however, since there are no unified state prices for alloys.

3.53 There are some signs that progress is being made on the alloy issue elsewhere in China. In Shanghai certain aluminum smelting plants were already producing some types of aluminum alloys directly in 1983. This has adversely affected aluminum processing factories (one of whose functions apparently had been to resmelt pure aluminum into alloys). In one such factory, monthly production in July 1983 was 21% below the level achieved a year previously. Nevertheless, in view of the fact that direct smelting of alloys conserves energy, processing factories were urged to accept and adapt to the new situation.[29/]

Relocation

3.54 There has been no effective response to the fundamental and increasingly severe location problem. The reasons why partial relocation through farming out part of production did not occur have already been discussed (see pp. 24-25). Here the alternative of completely stopping production at the current site and either building new capacity elsewhere in China or relying more on imports will be examined. The Shenyang Smelter apparently did consider moving production to a mountain ravine outside the suburbs of Shenyang, when attention was focussed on the pollution problem in 1978. But this alternative was rejected as being more costly than on-site pollution control and not solving the fundamental problem but just relocating pollution elsewhere.

3.55 It is instructive to compare the private financial costs and benefits (from the viewpoint of the smelter) and the social costs and benefits of a complete shutdown and relocation. The investment in production facilities at the new site would be a large cost on either a private or a social basis. One possible reason for a difference between the two would be distortions in the prices of the investment goods required, since these would make the "shadow price" differ from the existing financial price. Similarly, distortions could arise because the true opportunity cost of capital differs from the financial cost of capital to the plant.[30/]

3.56 Since the pollution fees the Shenyang Smelter pays at present appear to be relatively low, it shoulders only a small share of the social cost of the pollution it causes in Shenyang City. Therefore, the private benefits from moving this pollution to a remote area where it would cause less harm

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29/ Shanghai Wuzi Shichang, No. 146, 12/17/83, p. 1.

30/ Most fixed investment by the smelter is still financed by grants or the enterprise's own funds; loans for fixed investment carry low rates of interest; and loan repayment provisions put much of the burden on the government (since many enterprises can "deduct" payments of both principal and interest before paying profit taxes or remittances). In this situation the private financial cost of capital is substantially below the true economic cost. Other loan repayment provisions may make the cost to enterprises even lower. See Byrd and Tidrick (1984, pp. 34-37) for a more detailed analysis.

would be slight, though the social benefits of such a move might be quite large. Similarly, private benefits to the smelter of moving production to an area with more abundant energy supplies would be realized only to the extent that the price of electricity and other forms of energy is actually lower there.[31] But again, the social benefits in terms of allowing more production in energy-deficient Northeast China might be very great. The artificially low price of energy in China might cause further distortions.[32]

3.57 The divergences between private and social costs and benefits discussed so far are primarily related to distorted prices.[33] The "social responsibilities" of Chinese enterprises, a feature of the economic and political system, may be an even more important obstacle. In the state sector of the economy, workers are very closely tied to their enterprises, which virtually guarantee them lifetime employment and are now even responsible for providing jobs for their children. This means that it is administratively and politically extremely difficult to shut down an existing enterprise, probably almost impossible in the case of a relatively large employer like the Shenyang Smelter. Moreover, if a factory is relocated, the workers must be moved along with the facilities, presumably at the cost of the enterprise. If factory management is responsive to workers' personal concerns, their opposition to moving on personal and psychological grounds might carry considerable weight. Finally, enterprises' responsibilities toward their workers extend to a wide range of benefits, including most importantly provision of housing. This means that in any move, the enterprise would most likely have to pay for workers' housing and other facilities at the new site. The same would probably apply to any production-related infrastructure needed. Many of these costs might be borne by the enterprise's supervisory agency, but this would only strengthen its opposition to relocation as well.

3.58 The relative social costs and benefits of relocating existing factory workers along with the production facilities versus laying them off and hiring new workers at the new site depend on labor market conditions

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31/ Actually, despite the severe shortage of electricity in the Northeast, the price of electricity to industrial users is lower than in most other parts of China. The price paid by the smelter is only Y 0.05/Kwh (Y 0.035 before June 1983), compared with an average of over Y 0.065/Kwh in China as a whole. This lower price appears to be a historical legacy, set at a time when electricity resources in the Northeast were abundant relative to demand and relative to those in other parts of the country.

32/ Even with an appropriate regional price structure, a low overall level of energy prices would mean that the private financial benefits of moving would be less than the social benefits. This assumes that the proportional gap between the financial price and the "shadow price" of electricity would be the same across different regions.

33/ Pollution fees that do not cover the social costs of pollution can be considered a form of price distortion due to externalities, which is, however, common in market economies as well as centrally planned economies.

around the old and new sites. At one extreme, assume that labor market conditions in Shenyang are such that if the smelter's existing workers were discharged they could readily find new employment in productive activities, and moreover that production is being relocated to an area where supplies of workers with appropriate skills are available at no cost above the going wage rate. In this case the social costs of moving facilities only are negligible, while private costs for a Chinese enterprise would be relatively high (depending on how much of moving and relocation expenses of workers are borne by the plant).[34/] Alternatively, assume that the smelter's workers could not be easily reabsorbed into new jobs in Shenyang, but that adequate labor is available in the area of the new site. In this case the social cost of moving facilities only is that of dealing with the extra unemployment in Shenyang, but there is also some social benefit in the extra employment provided at the new site. However, a Chinese enterprise and its workers would pay relocation costs for labor without any corresponding benefit, which might be greater than the net social cost of relocating facilities without moving labor. Finally, if labor market conditions in Shenyang are poor and production is being relocated to a remote area (for pollution and energy consumption reasons) where appropriate labor is simply not available, the social and private costs of the two alternatives might be very much the same.[35/]

3.59 The fact that enterprises would have to pay for construction of workers' housing and other facilities and a large part of the necessary infrastructure at the new site would tend to further increase the private costs of relocation. Whether or not these higher private costs reflect increased social costs depends on the situation at the new site. Perhaps even more important, it is doubtful that a Chinese enterprise could sell its existing site, facilities, and workers' housing at full market value (which in a large city like Shenyang would be very high). This means that one of the social benefits of moving (freeing land and facilities for other use) is largely not translated into private financial benefit for the enterprise concerned.

3.60 This discussion shows how complex the comparison of private and social costs/benefits of different alternatives can be. But it appears that under no circumstances would it be much more costly from a social viewpoint to move facilities only than it would be to move facilities and workers

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34/ In any case, the costs would be borne by some combination of the plant and the workers themselves. However, workers with good employment prospects elsewhere in Shenyang would probably quit rather than move with the factory (provided that they could keep or get adequate housing).

35/ This assumes that the cost of attracting new labor to the new site (in terms of higher wages or moving costs) would be about the same as that of relocating existing workers from Shenyang.

together.[36/] This means that systemic features of the Chinese economy (namely the employment responsibilities of enterprises) tend to further enlarge the gap between the private and social net costs of moving caused by distorted energy prices and inadequate pollution fees or pollution control standards. Thus the factory's choice would be biased against relocation. To the extent that supervisory agencies are responsive to the same financial cost-benefit considerations as the smelter, their decisions would be similarly biased.

3.61 The choice between continued production at the present site and importing the same metals is in principle relatively simple. The domestic unit cost of production, with all inputs (including raw materials) evaluated at shadow prices rather than existing financial prices, should be compared with the (expected) international price, using the appropriate shadow exchange rate.[37/] The use of the existing production facilities should not be charged to the cost of domestic production except to the extent that these assets can be productively employed in other activities. But a strategy of importing should really be compared with the best alternative involving domestic production (whether at the present site or elsewhere in China). The optimal choice between continued production at the present site, relocation, and importing may well be different for different metals, depending on China's resource endowment, pollution, energy requirements and other aspects of cost structure, and international prices. Uneconomic domestic production may be called for on strategic grounds, but this kind of policy should be made explicit and its economic costs recognized.

3.62 In the case of electricity-intensive products like zinc and especially aluminum, importing can be viewed as a means of in effect importing electricity from parts of the world where it is relatively cheap. Electricity itself cannot economically be transmitted over extremely long distances and cannot be preserved over time. However, both of these can be accomplished when electricity is "embodied" in an electricity-intensive commodity like aluminum. Given the severe shortage of energy in China and the extreme shortage of electric power, an import strategy for electricity-intensive goods has much to recommend it.

3.63 A good example of the strong systemic obstacles to relocation and the suboptimal location patterns that are likely to result is what happened in the case of the Fushun Aluminum Plant, a large aluminum smelter also located in Liaoning Province. Production of aluminum is far more electricity-inten-

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36/ At worst, the smelter could let go its workers, move, and provide wages and benefits sufficient to attract the same workers to the new site. This alternative is always available, and other than some administrative costs of firing and hiring, it should be no more costly than moving plant and workers together, assuming that such moves with the factory are voluntary on the part of the workers.

37/ An alternative method is to derive conversion ratios for different types of inputs, whereby financial prices in renminbi can be converted directly into shadow prices in US dollars or some other foreign currency.

sive even than that of zinc. To make one ton of aluminum requires more than five times as much electricity as a ton of zinc, close to 100 times as much electricity as a ton of copper.[38] In electricity-deficient Northeast China, the case for stopping aluminum production at Fushun is therefore even stronger than it is for shutting down the Shenyang Smelter and moving copper, lead, and zinc production elsewhere. In recent years, Fushun has been operating at far below capacity, producing only about 35,000 tons of aluminum per year compared with a previous high of 100,000 tons. Provincial authorities have consciously and systematically diverted power supplies from Fushun to the Shenyang Smelter and other, less electricity-intensive uses.[39]

3.64 Due to the serious energy shortage in Liaoning, at one point provincial authorities suggested that the Fushun Aluminum Plant be moved to another part of China where electricity supplies are more plentiful, like Gansu Province.[40] This was debated at length, and a final decision was made only at the highest levels of China's government. In the end, it was decided not to move the factory, for two reasons: (a) the existing facilities and equipment would have to be written off, and (b) Gansu didn't want the plant anyway, since it would soon be short of electricity as well. The first justification has no validity since the existing capital assets are "sunk costs".[41] The second may be more reasonable, but what matters is the relative shortage of electricity, or in other words differences in the shadow price of electricity across regions. Finally, the alternative of simply importing the aluminum required apparently was not even considered, though

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38/ Electricity consumption in aluminum production in China is over 20,000 Kwh/ton, compared with 3,733 Kwh/ton for zinc and 224 Kwh/ton for copper at the Shenyang Smelter in 1982 (Li, 1983, p. 274, and Statistical Appendix, item 36). It is likely, however, that the figure for aluminum represents the total electricity consumption in production, whereas the figures for the smelter certainly do not include energy or electricity consumption in transforming ores into concentrated form at the mine.

39/ Central authorities apparently had no choice but to go along with provincial decisions on electricity allocation, cutting back shipments of raw materials to Fushun accordingly. This is a striking example of the effectiveness and impact of provincial control over distribution of a key input like power. In essence, production at Fushun appears to have been determined primarily by the Liaoning Economic Commission.

40/ This is a rare example of a lower-level government authority actually wanting to get rid of a large, profitable enterprise under its jurisdiction, but it is entirely understandable in view of the power supply situation in Northeast China. Liaoning probably wanted to remove factory and workers together, so it would not have to deal with any resulting unemployment problems.

41/ That is, the money has already been spent, so the economic value of facilities and equipment is only their opportunity cost (what their contribution would be worth if put to other uses).

this has been recommended as a suitable temporary measure for China in general.[42/]

3.65 The course of action eventually agreed upon was to keep Fushun in operation and build new thermal power plants (presumably financed by the central government) in the local area to meet its needs. This of course is just as economically inefficient from a national perspective as allowing Fushun to run at full capacity in the present situation (i.e. by diverting supplies from other uses), since at the margin the trade-off between using electricity for aluminum production and for other purposes remains the same.[43/] Moreover, if the cost of the new power plants is higher than that of adding new electricity capacity elsewhere in China and/or there are transport bottlenecks which hinder an increase in coal shipments into Liaoning, this decision could result in a deterioration in overall economic efficiency.

42/ Li (1983, pp. 274-275) suggests this course of action, noting that the electricity freed by importing aluminum can be used to create gross industrial output value equivalent to 14-25 times the cost of the imported aluminum (when valued in Chinese domestic currency at the former internal settlement rate of Y 2.8 to US$1).

43/ This assumes that the capacity of the new power plants is too small to change the overall power supply situation in Liaoning or in Northeast China.

IV. ORGANIZATIONAL REFORMS

4.01 The problems faced by China's nonferrous metals industry elicited a system-wide response in the early 1980s, whose core was organizational reform and recentralization of administrative control over the larger and more important enterprises in the industry. From the viewpoint of the Shenyang Smelter, organizational changes and recentralization were seen as providing a fundamental solution to the problems of the multi-headed leadership system which had plagued it.

4.02 This chapter will first touch on some of the industry-wide problems that hindered efficient exploitation of China's nonferrous mineral resources and slowed growth of industrial production. The most important measure to deal with these problems was the establishment of the China Nonferrous Metals Industry General Corporation (NFGC) in April 1983 and the subsequent transfer of large nonferrous metals mines and factories to its jurisdiction. Regional branch corporations were also set up under NFGC; one of these, the Shenyang Regional Nonferrous Metals Branch Corporation (SRC), became the immediate supervisory agency of the Shenyang Smelter. The process by which the smelter was transferred from municipal to central control was lengthy and subject to considerable bargaining. It provides an interesting example of how difficult recentralization can be when it must be based on a bureaucratic consensus among different government agencies and levels of government, including the at least partly voluntary acquiescence of local authorities relinquishing jurisdiction. Thus it will be discussed in some detail.

4.03 Organizational reforms and recentralization appear to have at least ameliorated many of the problems of the multi-headed leadership system as they affected the Shenyang Smelter. But some difficulties particularly in the supply system remain, and others may even have been exacerbated. Moreover, recentralization has engendered some new problems (actual and potential). The last part of the chapter will first look at the costs and benefits of the new system from the point of view of the smelter; then it will make some general comments on the impact on China's nonferrous metals industry as a whole.

Problems in China's Nonferrous Metals Industry

4.04 The State Economic Commission circular which set up NFGC highlighted six features of China's nonferrous metals industry[1/]: (a) mineral resources are scattered in remote, mountainous areas, so exploitation and production are difficult and working conditions are poor; (b) the gestation period for mine development is very long, around ten years in the case of a medium-sized mine; (c) mining output is very uneven; (d) investment requirements are much higher than in most manufacturing industries, and profits from mining are very low, so localities are generally unwilling to invest in mines; (e) the production stages of mining, concentration, smelting, and processing of finished metals require cooperation of different enterprises across the country; and (f) most

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1/ See State Economic Commission (1983b, pp. 435-436).

ores are shipped out of the mining area rather than being refined locally, so localities again have no incentive to develop production. Finally, nonferrous metals are important not only economically but also from a strategic point of view. These characteristics were seen as dictating a highly centralized form of industrial organization.

4.05 Though some of the problems mentioned are immutable physical/technical constraints, others are to a large extent the result of past government policies. These include the administrative structure and location pattern of the nonferrous metals industry, the structure of relative prices (particularly as between mining products and metals), and the supply system. An underlying basic problem is the widespread geographical separation of mines, smelters, and processing facilities. As has already been mentioned, the reasons for this probably rather inefficient location pattern are obscure, but they may have had something to do with the lack of industrial infrastructure in the mining areas (including underdevelopment of rich energy resources). The early establishment and expansion of nonferrous metals smelters in the more advanced coastal regions (which already had electricity networks), and the obstacles to relocation already discussed (see pp. 60-63), may have been an even more important factor.

4.06 Detailed information on the structure of China's nonferrous metals industry is not available, but it seems clear that it suffered more than most from the multi-headed leadership system that evolved in the aftermath of the Cultural Revolution. Even very large enterprises were put under provincial or lower-level jurisdiction, yet their production and raw material supply by necessity still had to be managed by the Ministry of Metallurgy; allocation of output appears to have remained closely controlled by the State Planning Commission and (when it was in existence) the State Material Supply Bureau. Thus the problems faced by the Shenyang Smelter may have been to a large extent typical of other smelters in the industry.

4.07 The nonferrous mining enterprises, on the other hand, faced a different, even worse set of problems. These included most prominently the difficult conditions for mining, poor transport, and lack of investment funds, which was at least partly due to low profitability.[2/] With decentralization of administrative jurisdiction and given the fact that mines were often widely separated from smelters, unduly low prices for ores must have had a strong adverse impact on incentives to invest in mine development. Local authorities in the mining areas would not gain much in the way of profits from investing in new mines or in expanding existing ones, while smelters and processors reaped high profits. Under a more centralized regime, by contrast, it would have been possible at least in principle to transfer investment resources from

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2/ Since prices of ores were nominally set by the Ministry of Metallurgy (now by NFGC), all they do is redistribute a given amount of economic surplus (determined by the state-set price of pure metals) between mines and smelters. The fact that the Ministry was unable to raise ore prices, if this was felt to be desirable, is a strong indication of the paralysis induced by the scattering of administrative jurisdiction and control.

the high-profit downstream activities to mines. After decentralization, however, local authorities in charge of smelters as well as the smelters themselves would resist price increases for ores, and other means of transferring investment resources were cumbersome.[3/]

4.08 While a number of serious problems in the nonferrous metals industry were longstanding, at least one is new, though in a certain sense it represents the culmination of the trend of administrative decentralization begun earlier. Until 1980, control over all foreign trade transactions had remained a monopoly of the Ministry of Foreign Trade, despite decentralization in other spheres of economic activity. The end of this monopoly meant that ministries and provinces could export independently and retain part of the foreign exchange earnings for their own use. Given the value of foreign exchange in an economy characterized by chronic domestic shortages, these organizations had strong incentives to increase exports. The ready marketability of nonferrous metals internationally (due to the fact that they are very nearly homogeneous products) led to a situation where organizations at different levels heavily promoted exports in order to earn and retain more foreign exchange. Some of these exports were probably excessive in view of domestic requirements. Even worse, in a few cases competing localities and organizations bid down prices by competing for export markets. This appears to have occurred most notably in the case of tungsten, for which China accounts for a large proportion of total world supply.[4/]

4.10 A concrete example of the kinds of problems such administrative decentralization/export promotion can cause is the case of the Anshan Iron and Steel Company and magnesium needed for refractory materials. Anshan had developed two magnesium mines in the local area to supply its needs, but in 1980 these mines were separated from the iron and steel complex and put under a new provincial magnesium company. This was done to improve management and technology by reorganizing numerous small locally-run mines, but also to promote exports of magnesium. This mining company's production and export plans are set by the Ministry of Metallurgy (the agency that is directly in charge of the Anshan Iron and Steel Company); magnesium bricks (for lining furnaces in steel plants) are reportedly Category 2 products whose distribution is controlled by this same ministry.

4.11 Despite this seemingly rather close organizational connection, Anshan was not allocated a sufficient quantity of magnesium bricks for a large

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3/ Some "voluntary" investment resource transfer mechanisms have evolved since the late 1970s. These include joint ventures and compensation trade between different regions of China. So far these appear to be less important in nonferrous metals than in certain other subsectors like coal and cement. But compensation trade appears to be widely used by units wanting to acquire tin from Yunnan Province.

4/ See The China Business Review, March-April 1983, pp. 38-40 for a discussion of the problems caused by competition among different Chinese organizations involved in exporting tungsten.

investment project (a new converter for the No. 3 Steel Plant) that was approved in 1982. As a result it had to request extra supplies from the mining company outside the plan. The latter (apparently with at least the tacit approval of the ministry) set virtually extortionate terms for meeting Anshan's extra needs, including a 15-year interest-free loan of Y 15 million, steady supply of 2,000 tons of crude oil per year, and large amounts of production materials. After lengthy negotiations these terms were modified somewhat and agreed on, but Anshan also received permission to import the needed magnesium bricks if the mining company failed to come through. This is paradoxical in view of China's extremely rich magnesium reserves (located in Liaoning) and its large exports.[5/]

4.12 Based on a brief conversation with a representative of the Anshan Iron and Steel Company in the summer of 1985, it appears that the final arrangement was for the mining company to provide magnesium materials to Anshan at an extra-high price. Anshan itself then built facilities to produce the magnesium bricks needed for its investment project. This raises questions about whether the size of the brick-making operation reached minimum optimum scale.[6/] It is also not clear what will happen in the future when Anshan's own requirements for magnesium bricks decline. Anshan would still appear to be dependent on the mining company for raw materials, which could be cut off or have their price raised further in the future.[7/] Overall, this case is a good example of the strong incentives for backward integration to create reliable sources of supply in an administratively run economic system. De-integration by administrative fiat often can cause severe problems for the downstream activities which no longer have assured access to raw materials.

5/ Annual production of magnesium is reportedly in the range of 600-700,000 tons, of which over 100,000 tons is exported. This case is especially interesting since it appears that the magnesium mining company remained under the jurisdiction of the Ministry of Metallurgy even after 1983; and indeed this problem came to ahead after the formation of NFGC.

6/ It is possible that economies of scale in the production of magnesium bricks are negligible, or that the capital costs are so low that the facilities could be disbanded after meeting Anshan's needs without any great waste. On the other hand, it is possible that the mining company lacked the technical expertise to engage in the production of magnesium bricks of adequate quality, in which case the best alternative was for Anshan to manufacture them.

7/ Anshan may be able to find a competing supplier of magnesium materials, but it appears that all the mines in Liaoning Province (where resources are most abundant) are under the control of the mining company.

The China Nonferrous Metals Industry General Corporation (NFGC)

4.13 Recentralization of control in China's nonferrous metals industry was decreed, along with the establishment of NFGC, in April 1983.[8/] Concomitant to this organizational change, over 100 nonferrous metals enterprises were transferred from local to central control in 1983, and more were expected to be transferred in 1984. When the process of transfers is completed, there will be over 200 enterprises under NFGC; they will account for 70% of total physical output in China's nonferrous metals industry (71% of output value) and 82% of profits.[9/]

4.14 The nucleus of NFGC in terms of both personnel and organizational structure was formed from the Nonferrous Metals Industry Bureau under the Ministry of Metallurgy, which had previously been responsible for the industry. But the new corporation is a "state enterprise," an independent accounting unit reporting directly to China's State Council rather than to the Ministry of Metallurgy. In administrative terms, its "rank" is nominally equivalent to that of a ministry. As such, it is responsible for overall planning of China's nonferrous metals industry and imports and exports. At least formally, it is supposed to exercise centralized leadership over production, supply, and marketing and finances, personnel, and materials.

4.15 More concretely, the 30% of depreciation funds of nonferrous metals enterprises previously handed over to government financial authorities is now given to the headquarters of NFGC for reinvestment in nonferrous metals. In another key area, a national tungsten company was set up under NFGC, which would take control of 15 tungsten enterprises previously turned over by the central government to local jurisdiction. Gold and silver are subject to a more complicated arrangement. The national gold company will still be managed by the Ministry of Metallurgy, but investment funds to develop gold and silver production that accrue to nonferrous metals enterprises producing these metals as byproducts will be given directly to NFGC by the People's Bank of China.[10/] Finally, all new large and medium-sized nonferrous metals enterprises established hereafter will be under NFGC, but local governments that provide investment funds can share in the profits in accordance with investment shares.

4.16 The ability of NFGC effectively to centralize administrative control was weakened by at least two important provisions. In the first place, trans-

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8/ See State Economic Commission (1983b). Unless otherwise indicated, the discussion in this section on the nature and role of NFGC is based on this document.

9/ "China Economic Yearbook" Editorial Committee (1984, p. V-152).

10/ Apparently enterprises that produce gold and silver are allowed to retain specified amounts of funds for investment in further expansion of production. These funds may be tied to the physical output of gold and silver.

fer of enterprises from local to central jurisdiction was in principle supposed to be voluntary, and the financial interests of the governments "losing" their enterprises were supposed to be safeguarded.[11] This meant extensive negotiations and delays, like those which occurred in the case of the Shenyang Smelter (see pp. 74-75 below). Secondly, NFGC was to exercise direct administrative control over only some 20 especially large and important plants (like the Northeast Light Alloys Processing Factory, which fabricates metal parts for aircraft). The rest of the centralized enterprises (including the Shenyang Smelter) were to be divorced from local governments in their financial relationships but managed by newly-established regional branch corporations.[12] The exact status of these entities is vague; in some respects they appear to be provincial-level units and as such they may be responsive to provincial rather than national priorities. This is particularly true since these organizations have been formed (and largely staffed) from departments responsible for nonferrous metals in provincial metallurgy bureaus.

4.17 The net effect of these provisions weakening direct central control by NFGC as well as other forms of bureaucratic inertia may have been greater centralization in the financial sphere than in the planning/production/supply sphere.[13] Perhaps even more important, systemic obstacles to promoting a more efficient industrial structure and a more rational location pattern may not have been significantly weakened (see Chapter V). If this is true, then one of the main advantages of administrative centralization, the ability to make major reallocations of resources which inevitably have a detrimental effect on some regions and enterprises, may have been lost.

The Shenyang Regional Branch Corporation (SRC)

4.18 This organization formally came into being only in December 1983, less than a month before the Shenyang Smelter was transferred to its jurisdiction. The nucleus and 80% of the staff came from the unit within the Liaoning Provincial Metallurgy Bureau (LMB) responsible for nonferrous metals. The remaining 20% of staff came from enterprises, about 7% from the Shenyang Smelter. SRC has three deputy managers: one was previously director of the Fushun Aluminum Plant, another was a deputy director of the Anshan Iron and Steel Company Economic Research Institute (the only leading cadre brought in from outside the Liaoning nonferrous metals system), and the third was previously a deputy director of LMB responsible for nonferrous metals. The

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11/ This principle may have been often violated in practice. In the case of the Shenyang Smelter, arguments centered around the terms of the transfer rather than whether it was to occur at all.

12/ "China Economic Yearbook" Editorial Committee (1984, p. V-152).

13/ Of course under the previous decentralized regime, production planning, raw material supply, and distribution of output remained under considerable de facto central control. It is doubtful whether the 1983 recentralization did anything more than eliminate this initial imbalance.

fact that a manager had not yet been chosen at the time of interviews with the smelter (10 months after the establishment of SRC) probably reflects continuing uncertainty about its exact position and role.

4.19 In formal terms, the functions of regional branch corporations are spelled out in the State Council circular that established NFGC.[14/] Twelve branch corporations have been set up altogether; though they are named after the cities they are located in rather than provinces, their territories appear to be divided very much along provincial lines.[15/] They are supposed to supervise centralized enterprises located in their area of jurisdiction which are not directly managed by NFGC. Also, if deputed to do so by provincial authorities, they can coordinate and plan the activities of small local nonferrous metals enterprises, (which had not been transferred to central control). This was probably part of the responsibilities of provincial metallurgy bureaus previously. These two functions may conflict. For example, SRC apparently has forced the Shenyang Smelter to buy more lead ore than it needed from a local lead mine that was also under SRC. This meant that the smelter had to refuse supplies from suppliers designated in the central plan.

4.20 The regional branch corporations are given financial incentives, in the form of quotas for profits to be turned over to NFGC. These quotas are disaggregated to individual enterprises by the branch corporations. Above-quota profits are divided between the branch corporation and the enterprises, usually 30-70 or 40-60, with the lower share going to the enterprise. Apparently no above-quota profits are turned over to NFGC. It was stressed, however, that financial arrangements for the regional branch corporations were provisional and subject to change.

4.21 The institutional nature of the regional corporations in general and of SRC in particular had not been settled at the time of the interviews. At the moment they are formally administrative branches of NFGC, though they do have some autonomy and financial incentives; their "rank" is similar to that of provincial metallurgy bureaus (corresponding to the relative positions of NFGC and the Ministry of Metallurgy at the national level). On the other hand, since they were formed and largely staffed from provincial metallurgy bureaus, they must retain informal ties with provincial authorities, particularly since they also oversee small, locally-run mines. SRC and other regional branch corporations would prefer that they become economically independent enterprise-type units, which would increase their independence and

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14/ State Economic Commission (1983b, p. 437).

15/ In the case of SRC, there were differences of opinion as to whether the corporation had jurisdiction over any nonferrous metals enterprises located outside of Liaoning Province. NFGC in Beijing stated that SRC was only in charge of enterprises in Liaoning. A deputy director of the Shenyang Smelter asserted that SRC runs two small mines in neighboring Jilin Province and one in Heilongjiang. A representative of SRC itself said that one of the 18 enterprises under SRC is in Nei Monggol, the rest in Liaoning.

financial autonomy. On the other hand, most nonferrous metals enterprises apparently prefer the present arrangement, while the Shenyang Smelter itself would most like to be directly managed by NFGC and have nothing to do with SRC. Large enterprises fear that making regional branch corporations economic entities would result in a reduction in their own independence. The attitude of NFGC may be ambivalent.

The Transfer of Control Over the Shenyang Smelter

4.22 It is not surprising that the Shenyang Metallurgy Bureau (SMB) strongly resisted losing its largest and most profitable enterprise (the Shenyang Smelter accounted for 55% of the gross industrial output value and 60% of the profits of SMB). The Shenyang Municipal Finance Bureau also was concerned, since the smelter accounted for close to 13% of the city's profits from industry. The sharp drop in profits suffered by the plant in 1983 aggravated the conflict. It appears, however, that arguments about the distribution of the smelter's products were not a major source of contention.[16/]

4.23 The formation of NFGC was considered as early as September 1982; the State Council document came out in April 1983; and apparently by May 1983 a list of factories to be transferred from local to central control (including the Shenyang Smelter) had already been promulgated. But a serious dispute about financial aspects held up consummation of the transfer until the end of the year. The main disagreement concerned the profit "base" to use in adjusting Shenyang Municipality's profit (revenue) remittance quota vis-a-vis Liaoning Province. Shenyang Municipality naturally wanted to use the 1983 initial enterprise profit remittance target of Y 46.2 million as the base; it would benefit from this because its target would then be adjusted downward by a relatively large amount.[17/] The smelter, however, only thought that it could remit Y 35.2 million (later lowered further to Y 29 million).

16/ Only NFGC mentioned this as an issue, stating that when the smelter was transferred there was a written agreement between NFGC and Shenyang Municipality which specified that among other things a small proportion of some of the plant's products would be turned over to the city. Representatives of the smelter and SRC denied there was any such agreement, pointing out that the city had not had the right to allocate any products previously, either. In the case of sulfuric acid, a stable distribution of output between the State Material Supply Bureau, Liaoning Province, and the Shenyang Smelter was maintained, apparently without the benefit of any formal written agreement (see p. 56).

17/ This of course was an important incentive for Shenyang City and SMB to set an unrealistically high profit target for the smelter, an incentive that was not present before attempts were made to change the multi-headed leadership system. The problem of excessively high profit targets thus may to some extent have been limited to 1983, due to the decrease in profits and uncertainty about changes in the administrative system.

4.24 The problem was eventually solved apparently at least in part through the initiative of the smelter itself. It got together with the Liaoning Metallurgy Bureau (LMB), which went to NFGC to discuss the matter. NFGC in turn went to the Ministry of Finance. Eventually the ministry decided that the Y 29 million figure should be used as the base, but apparently Shenyang Municipality's revenue target would be adjusted downward retroactively to reflect the enterprise's lower profits. In this situation the city would readily agree to use Y 29 million as the base, since its target had already been adjusted downward by the difference between Y 46.2 million and Y 29 million.[18/]

Benefits of Recentralization

4.25 Transfer of operational control over the Shenyang Smelter from SMB to SRC and the ending of the plant's administrative and financial relationship with Shenyang Municipality has had considerable benefits. SMB was a very poor "patron" from the smelter's point of view: it made demands, diverted resources from the factory to other enterprises under its jurisdiction, and set excessively high targets. On the other hand, SMB was unable to provide much help to the plant in the crucial area of supply, and had no expertise on technical aspects of production. In fact, it sometimes was an obstacle on supplies, making it difficult for the Shenyang Smelter to obtain them directly even when SMB could not provide them. It is doubtful whether SMB gave any assistance on the marketing side, either. All in all, from the enterprise's perspective SMB must have been seen as a superfluous organization, whose interference far outweighed any help it could provide.

4.26 In this situation, recentralization completely got rid of one of the "heads" of the multi-headed leadership system and was therefore almost unambiguously beneficial. Any minor problems that emerged as a result of the loss of the connection with Shenyang Municipality (see p. 77 below) were minuscule compared with this. In this respect the smelter is different from most other factories, which derive concrete benefits from their relationships with local governments and would lose (though they might also gain in other aspects) from any recentralization.[19/]

4.27 One of the concrete benefits of recentralization is a better situation with respect to supply of Category 1 construction materials, which are the responsibility of Liaoning Province but which previously were in part

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18/ Liaoning Province probably also had an appropriate adjustment made in its revenue remittance target vis-a-vis the central government, in which case it also would have been happy about the situation. This would mean that all of the burden of the Shenyang Smelter's 1983 decline in profits was borne by the Ministry of Finance.

19/ The Qingdao Forging Machinery Plant is one example. See Chen Jiyuan et al (1984). The Sanchazi Forestry Bureau in Jilin Province is another.

diverted by SMB to other factories under its jurisdiction.[20/] It also appears that the conflict between output and profit targets has been ameliorated though by no means eliminated. In 1983 the gap between the initial profit remittance target set by SMB and what the Shenyang Smelter thought it could achieve was 30%. In 1984 the gap between the initial target set by SRC and what the smelter thought it could reach was only 15%, and more significantly, the plant did not ask for any revision in the target, feeling that it could meet the SRC target through extra diligence.[21/]

4.28 In some areas, recentralization may not have had any significant benefits, but at the same time it appears not to have done any harm. An example is electricity supply, which is handled in exactly the same way as before. Even here, the close tie with SRC may help somewhat. The same is true of the supply of coal and other material inputs that are subject at least in principle to provincial control. In the crucial area of labor allocation, recentralization appears not to have brought any major changes, and there is no indication that Shenyang Municipality has caused major problems since the transfer.

New and Continuing Problems

4.29 The main unanswered question concerns the role of SRC. If it emerges as an economically independent entity with considerable powers, the Shenyang Smelter may increasingly view it as an obstacle similar to SMB in the past. There are important matters which the plant can deal with only by going directly to NFGC, an example being arrangement of extra supplies of domestically-produced blister from the Daye plant in Hebei and elsewhere. SRC can provide no help in this area.[22/] Moreover, SRC has already proved to be an obstacle in at least one case: It has forced the smelter to buy lead which it does not need from a small local mine and refuse shipments from suppliers

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20/ The market for steel, cement, and timber has tightened considerably since 1982, but the smelter felt that the situation had been improved by the recentralization (presumably at least relative to what it otherwise would have been). However, the enterprise had to get into a fairly costly compensation trade arrangement with the Benxi County Cement Plant (which predated the recentralization) in order to obtain sufficient supplies of cement (see p. 54). In fact, through this deal the plant now sometimes gets more cement than it actually needs, which it either exchanges with peasants of Panjin Prefecture for natural gas to meet employees' cooking needs or simply does not purchase (leaving it for Benxi to allocate).

21/ This implies that the 15% gap is at least to a large extent merely part of the bargaining process. In 1983, of course, the real gap was even larger than 30%, since the smelter fell considerably short of its own initial predictions. The SMB initial profit remittance target was nearly 60% higher than actual performance.

22/ This is almost certainly true of imported raw materials as well.

designated in the central plan.[23/] SRC responsiveness to the needs of small, locally-run nonferrous metals mines may be an indication of potential future problems. Indeed an economically independent SRC with considerable decision-making authority might become more responsive to provincial interests than to direction from NFGC.

4.30 The problematic situation of SRC and other regional branch corporations in China's nonferrous metals industry has some broader implications for the structure and role of corporations in Chinese industry as a whole. Current policy stresses that corporations should be true economic entities rather than administrative agencies that differ only in name from industrial bureaus. But enterprises may well prefer to be under the supervision of a relatively weak administrative bureau rather than a more powerful business corporation that is oriented toward increasing its own profits. Some economically independent corporations use their supervisory position vis-a-vis enterprises to levy fees on various enterprise transactions, unrelated to any services provided to the enterprises. Thus the financial position and role of corporations can have a strong impact on enterprise autonomy and incentives.

4.31 Certain concrete problems have emerged as a result of the estrangement of the Shenyang Smelter from Shenyang Municipality, but these are most probably small in relation to the benefits. The most important one is more careful monitoring of the plant's pollution by local authorities and the imposition of progressively larger pollution charges. In 1980-1982 the smelter paid no fees at all for waste water. In 1983 a fee of Y 5 million was levied, and in 1984 it was increased to Y 6.2 million. 80% of these charges are still returned to the factory for investment in pollution control projects. The smelter also faces greater difficulties in obtaining locally-controlled Category 3 building materials and other supplies. In some cases price increases have been imposed, and some prices may be higher than those paid by other customers.[24/] But in most cases tightening supplies and price increases reflect general market trends which would have been felt even in the absence of recentralization.

4.32 Despite undoubted improvements, the creation of NFGC and the recentralization of control over the Shenyang Smelter appear not to have touched the most fundamental problems faced by the plant. It is doubtful whether these changes will have any effect at all on the location problem, though shutting down the smelter and moving production elsewhere may be easier now that the financial relationship with the city has been severed. Irrationalities in the supply system remain, and it is not clear to what extent the allocation of investment funds will be improved. Difficult questions regard-

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23/ Of course this may well be the best thing to do from a national perspective, if the true economic cost of producing lead ore of comparable quality locally is less than the cost of mining it elsewhere and bringing it in (including transport costs).

24/ For example, the local price for roof tiles made of refractory materials is Y 6.7, but the smelter was forced to pay Y 8.

ing possible future development of alloy production appear not to have been resolved. The chaotic market for scrap copper and inefficient recycling of scrap by small enterprises seems completely unaffected by the recentralization.

Questions for the Future

4.33 Looking beyond the Shenyang Smelter to the Chinese nonferrous metals industry as a whole, a number of questions arise about the recent organizational reforms and administrative recentralization. The new system is still to some extent fluid, and final decisions appear not to have been made on certain key issues (most notably the institutional nature and functions of the regional branch corporations). Therefore the comments in this section should be considered highly tentative; moreover, they often point out potential future problem areas rather than difficulties already being encountered.

4.34 The multi-headed leadership system came about as a direct result of differing degrees of administrative decentralization in different spheres of operations. It is therefore not surprising that differing degrees of recentralization would be an important issue in the 1983 organizational reforms. Recentralization in the financial sphere (control over profit remittances) appears to have been greater than in other spheres (most notably supply of raw materials). Whereas large and medium-sized enterprises now hand over their profits to the central government (most of them through the regional branch corporations), there appears to have been no corresponding change in the realm of raw material supply, since ores from larger mines were centrally allocated all along. Recentralization appears not to have had any effect on the distribution and utilization of scrap copper, either. To a large extent uneven recentralization has merely redressed the earlier imbalance, when financial control was quite decentralized but production and supply to a considerable extent remained under central control. This pattern of recentralization may lead to problems in certain areas. Centralization of finances leaves open the possibility that enterprise-level incentives may be harmed if controls are tightened in the future. At the moment the danger of this happening is minimal, with the quota system now in place apparently providing strong profit incentives to enterprises. But this could change.

4.35 Another potential problem area is supplies of raw materials outside the plan. Financial recentralization almost certainly has decreased the financial stake of provinces in the nonferrous metals industry. This may harm incentives for them and lower levels of government to arrange supplies of ores to smelters. Small mines account for one-fourth of China's total output of nonferrous metals ores, and scrap is not subject to allocation through the central plan, so this could become a severe problem. With prices of ores so low in relation to those of pure metals, small mines already are generally willing to supply ore to smelters only if they (in practice their local governments) have control over the output generated. A similar pattern is

emerging for scrap copper.[25/] The rigidity of barter and the various types of processing arrangements used certainly hinders flexible adjustment of supply to demand. Perhaps more important, it strengthens the position of organizations which have de facto control over the allocation of these supplies (SRC in the case of ores from small mines supplied to the Shenyang Smelter). This may well go against the intent of organizational reforms.

4.36 Control over raw materials is just one of several reasons why the future role of regional branch corporations is problematic. The most important question is who these organizations will respond to, the provinces in which they are located or NFGC in Beijing. Another issue is the degree of control they will exercise over enterprises. There is the possibility that they may eventually be able to manage subordinate enterprises rather tightly. This would probably not be appropriate in the case of large, fairly self-contained enterprises like the Shenyang Smelter.

4.37 A related question concerns the degree to which NFGC will gain the ability to make necessary adjustments in prices (at least for those that are nominally under its control), redistribute resources between mines and smelters, shut down plants where appropriate, etc. Up to now, NFGC does not appear to have gained the authority to do much in these areas. As has already been mentioned, this means that one of the main advantages of administrative centralization may have been lost. Perhaps even more important is the issue of NFGC's capability to do coordinated long-term planning of the nonferrous metals subsector. There is no point in strengthening its ability to implement plans for the industry as a whole if it is not able to do good sector planning in the first place.

4.38 A final set of questions concerns aspects which at present are largely out of the control of NFGC as well as that of nonferrous metals enterprises. Alloy production is the most obvious one. It is probably irrational for smelters to be prohibited from producing alloys. On the other hand, users would have to be assured that they would receive timely supplies of alloys of appropriate specifications before they would give up their own production (even then they might not do so voluntarily). The best method of shifting alloy production from users to smelters is probably not to transfer administrative control over production and distribution of alloys from user ministries to NFGC. Instead, allocation should be freed up to the extent possible, with smelters allowed to produce alloys for users, supply based on contracts between the two, and increasing flexibility in pricing.

4.39 Something also needs to be done about the distribution and inefficient recycling of scrap copper. A way must be found to ensure that scrap is reprocessed at highest efficiency, which generally means it should be done by larger smelters using careful quality control. But again, this is

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25/ The importance of shortage in generating this pattern is shown by lead. Since lead is not in great excess demand and there may be an emerging surplus, small lead mines and suppliers of lead scrap are not interested in barter or processing arrangements.

probably best accomplished not by administrative measures but rather by making it economically profitable for all concerned to use this method. Ordering inefficient small scrap reprocessors to close down and for copper scrap to be delivered to a specified government organization would probably cause supplies of scrap copper to dry up. On the other hand, the barter and processing arrangements being resorted to now are probably overly rigid. Greater price flexibility for scrap combined with allowing smelters to pass on the resulting higher costs in higher prices for metals is in principle the best method, but it may increase inflationary pressures. Allowing more imports of copper (which has already been done in 1983 - see Tables 1.4 and 1.6) would help ease the pressures on the domestic scrap market.

V. GENERAL OBSERVATIONS

5.01 The experience of the Shenyang Smelter in recent years shows both marked contrasts and some similarities with that of the Chongqing Clock and Watch Company (CCWC), which represents an extreme in terms of reforms and market orientation.[1] CCWC was an expanding enterprise still at a relatively early stage of the "learning curve," which became fully engaged in watch production only shortly before the period of reform implementation. The smelter, by contrast, is an old enterprise with limited expansion potential and increasingly restricted opportunities for increasing profits through recovery of byproducts, reducing material input consumption and energy usage, etc. CCWC is a producer of high-priced consumer durables which received at least some priority in allocation of resources during the readjustment period. On the other hand, the Shenyang Smelter is a producer of key strategic materials, but it seems not to have received priority in allocation of investment resources. The smelter produces very nearly homogeneous goods, while CCWC makes differentiated products. CCWC participated in one of the most advanced financial reform experiments ever tried out in China (an early version of the income tax system); the Shenyang Smelter's experience with financial incentive systems appears to have been about average for enterprises of its size. Perhaps most important, the smelter requires very large amounts of raw materials and energy in its production, while CCWC is much less dependent on these.

5.02 These differences overwhelm any similarities, which nevertheless deserve mention. Both enterprises are relatively profitable. Both seem very responsive to the interests of employees and their dependents, though this was manifested in different ways. Perhaps most important, both CCWC and the Shenyang Smelter were forced to turn away from a focus on pure output expansion to an "intensive" response, involving various kinds of efficiency-improving activities. In CCWC this intensive response was induced by a weak market and refusal of commercial departments to indiscriminately purchase its output. In the case of the smelter, expansion was blocked in the first place by physical constraints. The response of the two enterprises differed greatly in detail. That of CCWC was clearly market-oriented: it took measures to promote sales and ensure that what it produced was in accordance with market demand. The Shenyang Smelter has been much less market-oriented; it has focused on measures which can increase financial returns (and reduce pollution) in the absence of output expansion, like recovery of byproducts and energy conservation, and on possibly uneconomic improvements in quality, probably based on its desire to build up a good reputation vis-a-vis supervisory authorities.

5.03 This chapter will try to distill some more general conclusions based on the experience of the Shenyang Smelter. Since this has been in many

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1/ See Byrd and Tidrick (1984, pp. 48-49 and 69), for a brief discussion of the question of the replicability of CCWC's shift to intensive growth. Comments on CCWC in this chapter are all based on this source.

respects so different from developments at CCWC, the observations made here should be a useful complement to those in Chapter 4 of the study of CCWC. However, the same caveats about the danger of basing general conclusions on the experience of one enterprise or a small sample of enterprises still hold. We will start with an evaluation of the smelter's performance, first in narrow technical and financial terms, taking as given the limitations on its freedom of action. Then the discussion will turn to industry-wide considerations, in particular the efficiency of the administrative structure and location pattern of China's nonferrous metals industry as a whole. Finally, some tentative comments broadly applicable to Chinese state-owned industry in general will be put forward.

The Shenyang Smelter's Performance

5.04 As is clear from Chapter III, the smelter made great efforts to reduce energy consumption, raise quality standards, recover more byproducts from ores, increase profits, and reduce pollution in recent years. Measured performance (changes in production costs, profits, input consumption, etc.) often does not fairly reflect these measures, as can be seen from Table 5.1. Unit production costs for copper and zinc in 1982 were the highest of any year for which information is available, while 1982 lead production costs were only five percent below the level of 1975. The average rate of profit on sales declined in 1976-1978 and then rose sharply in 1979-1980, before falling again somewhat in 1981-1982; the net result was a modest one percent rise between 1975 and 1982. There was undoubtedly a severe drop in profitability and a rise in costs in 1983.

5.05 Indexes of material input consumption and electricity usage show only modest improvements amid considerable year-to-year variation. Loss of lead in smelting declined from nine percent in 1975 to 5.5 percent in 1982; for zinc the drop was from 5.5 percent to 3.7 percent; and for copper from 3.3 percent to 2.9 percent. Compared to the national average for key enterprises in 1982, the smelter's loss rate was somewhat lower for zinc, exactly the same for copper, and slightly higher for lead.[2/] Electricity consumption in copper production (electrolysis) fell unevenly, that for lead declined somewhat more steadily, and electricity consumption in zinc production stayed about the same.

5.06 There are a number of reasons for the superficially poor performance in lowering production costs. In the first place, wage costs rose considerably after 1977, with average income per worker growing at an average annual rate of 6.1 percent in 1977-1982. This increase in average wages was fully translated into unit wage costs, since real gross output per worker was almost

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2/ State Statistical Bureau (1983, p. 281). This comparison and changes at the smelter over time are not very meaningful without an understanding of changes in the quality and varieties of ores and the impact these might have on input consumption.

Table 5.1: SHENYANG SMELTER EFFICIENCY INDICATORS, 1975-1982

	1975	1976	1977	1978	1979	1980	1981	1982
Production Cost (Y/ton)								
Copper /a	4,722	4,729	4,827	4,768	4,170	4,792	4,811	4,836
Lead /a	1,886	1,899	1,925	1,882	1,852	1,884	1,829	1,793
Zinc	1,531	1,575	1,571	1,528	1,478	1,589	1,569	1,652
Loss of Metal Content in Production (%) /b								
Copper	3.3	3.2	3.2	3.0	3.0	3.0	2.9	2.9
Lead	9.0	8.6	9.3	6.8	5.9	5.8	5.7	5.5
Zinc	5.5	5.5	5.5	4.3	4.1	3.9	3.8	3.7
Unit Electricty Consumption (kWh/ton) /c								
Electrolytic copper	259	260	259	251	257	269	265	224
Electrolytic lead	193	195	206	191	183	174	152	145
Electrolytic zinc	3,715	3,793	3,879	3,680	3,650	3,670	3,680	3,733
Labor Productivity (Y/Employee) /d								
Gross output value per employee (in current prices)	n.a.	77,239	69,304	80,448	86,161	106,002	108,256	101,092
Net output value per employee (in current prices)	n.a.	11,218	9,104	10,819	13,408	15,494	14,977	13,870
Gross output value per employee (in 1970 constant prices)	77,733	77,239	65,242	75,966	80,537	88,547	83,566	78,061
Capital Productivity /e								
Gross value of output at current prices/original value of fixed assets	n.a.	4.14	3.10	3.17	3.45	3.89	3.99	3.85
Gross value of output at constant prices/original value of fixed assets	4.24	4.14	2.92	2.99	3.23	3.25	3.08	2.97
Circulating capital/sales	0.294	0.246	0.253	0.208	0.239	0.258	0.211	0.186
Financial Indicators (%) /f								
Profit rate on sales	7.4	6.9	5.8	4.0	8.7	9.9	9.5	8.4
Tax rate on sales	6.5	6.3	6.5	6.1	6.0	5.7	5.7	5.7
Profit rate on fixed assets	29.6	27.7	16.4	11.7	27.6	31.3	31.0	28.3

/a These are unit costs for producing copper and lead from concentrated ores (including the price paid for concentrates).

/b This is the ratio of final metal output to the total metal content of raw materials, minus one (and then converted to a percentage basis). Based on the corresponding figures in national statistical publications, it appears that these figures refer to the loss rate in conversion of unrefined metal (blister in the case of copper) to pure metal, rather than the losses in smelting ores, which can be quite substantial (see State Statistical Bureau, 1983, p. 281).

/c It is not clear whether these figures refer only to electricity consumption in electrolysis. In any case, they do not include electricity consumption in mining or concentrating ores.

/d The employment figures used are for the total number of state employees (Statistical Appendix, item 9). If collective workers in "mixed" positions were included, the productivity figures would be somewhat lower.

/e The constant-price gross value of output figures are at 1970 prices. Fixed assets are valued at original purchase price, without adjustment for depreciation or revaluation. The figure for circulating capital is total "quota" circulating assets (Statistical Appendix, item 14).

/f The profit figures used are those for administrative profits (Statistical Appendix, item 26); taxes are indirect taxes only (in item 22).

Source: Statistical Appendix, items 1, 2, 3, 9, 11, 14, 21, 22, 26, 34, 36 and 42.

the same in 1982 as in 1975.[3/] More important, prices of many material inputs used by the smelter have risen substantially, though no figures are available on the impact on costs.[4/] But the main reason for less-than-dramatic improvements in efficiency indicators is simply the very restricted and deteriorating environment in which the Shenyang Smelter had to function. In certain spheres reform implementation has been minimal, further limiting the smelter's options.[5/] As a "mature" enterprise, the plant has less potential for efficiency improvements through moving along the "learning curve," and for output expansion accompanied by declining marginal costs. Thus merely avoiding a marked deterioration in efficiency should be considered a sign of successful performance under the circumstances.

5.07 An example of how the restricted and deteriorating environment adversely affected performance despite the smelter's best efforts is energy consumption in the first eight months of 1983. Average consumption rose from 2.94 tons of standard coal-equivalent (7,000 kcal heat content per ton) for each Y 10,000 of gross industrial output value generated in the first eight months of 1982 to 3.43 tons in the same period of 1983, a rise of 16.7 percent. However, this is more than explained by changes in various "objective factors," based on the smelter's calculations. These included: (a) a rise in the share of copper concentrate (which requires energy-intensive smelting) in total raw material supplies, with a corresponding decline in the share of scrap and blister (this contributed an increase of 0.1 tons/Y 10,000 in energy consumption); (b) use of more adulterated scrap, which required longer refining to get rid of impurities (0.054 tons/Y 10,000); (c) an overall shortage of raw materials, which caused stoppages and waste of energy at the furnaces (0.052 tons/Y 10,000); (d) a deterioration in the quality of copper and lead concentrate received, which required more energy in smelting (0.033 tons/ Y 10,000); (e) full burning of flue gas from the more adulterated ores, which required more energy (0.092 tons/Y 10,000); and (f) an increase in energy consumption due to expansion by subordinate collective enterprises (0.189 tons/Y 10,000).

3/ If collective workers employed in "mixed" positions were included, there might even have been a decline in output per worker. This stagnation in labor productivity should not be blamed on the enterprise, however, since it had little discretion in hiring and was forced to meet the very great employment needs of workers' children.

4/ In the first half of 1983, about two-thirds of the decline in profits was reportedly caused by rising input costs. Large price increases for gasoline, asphalt, and various other goods in 1983 were reported in interviews.

5/ This may have been due in part to slower reform implementation in Northeast China than elsewhere, in part to lags in the industry to which the smelter belongs (nonferrous metals), and in part to enterprise-specific factors.

5.08 Added together, the estimated impact of these factors is slightly greater than the actual increase in energy consumption, which implies that in a real sense the smelter had improved the technical efficiency of energy utilization somewhat, despite the increase in actual unit energy consumption. Though the precise methodology and quantitative results of this exercise may be questioned, it supports the hypothesis that if the deteriorating situation is taken into account, the enterprise has made some improvements in technical efficiency in recent years.

5.09 In view of the difficult situation the Shenyang Smelter faced in many respects, and based more on qualitative impressions than on hard quantitative evidence, a tentative evaluation of the enterprise's performance and certainly of its efforts to improve efficiency would be positive. This of course takes the external environment and the smelter's lack of freedom of action as given. More important, this section has focused on the micro level, ignoring possibilities for improving industry-wide efficiency through more radical changes. It should also be noted that the smelter's response was not strongly oriented toward meeting the needs of customers, which is only to be expected since most of its products have been chronically in short supply. Thus many of its actions appear to have been motivated by the desire to increase profits on the one hand or to gain and maintain a good reputation with government authorities on the other.

Industry-wide Considerations

5.10 Whatever the benefits of the Shenyang Smelter's micro-level improvements in efficiency, they are dwarfed by the magnitude of the problems it faces. The worst and most fundamental of these, poor location, has been virtually unaffected by the plant's actions. Even more important, organizational reforms and recentralization of control in the nonferrous metals industry as a whole so far appear not to have generated the means or the will to undertake drastic measures to rationalize industrial structure and improve location patterns.

5.11 It is paradoxical but nevertheless possible that the Shenyang Smelter's relatively strong performance at the micro level (improving efficiency "in the small") may actually have hindered possible future efforts to improve industry-wide performance (efficiency "in the large"). A fundamental solution to the smelter's problems probably can be achieved only by drastic measures involving relocation to a better site elsewhere in China or perhaps shutting down the plant entirely and relying more on imports. To the extent that the smelter's good performance has improved its standing and reputation, it may have become more difficult for higher-level authorities to contemplate taking any such action.

5.12 In China the phenomenon of relatively advanced and rapidly growing enterprises being held back from fully exploiting their potential because of "protection" of backward enterprises is well-known. The backward enterprises as a group of course are more likely to be hurt rather than helped by these

policies over the long run.[6/] The case of the Shenyang Smelter is somewhat different. Here we have an "advanced" enterprise, which has done well given its limited resources and restricted environment. But a careful analysis from a national perspective might well conclude that it should be phased out and replaced by increased production elsewhere in China or by imports (at least in the case of copper). This would mean there should be no new investment, and production should be reduced and eventually stopped entirely in a coordinated, planned way. Given the difficulties in closing down even inefficient, poorly managed, and small state-owned industrial enterprises in China, the prospects for such action or even a careful consideration of the alternatives in the case of the smelter are bleak. The fact that the smelter is highly profitable in purely financial terms (as a result of the distorted structure of relative prices, particularly artifically low prices of energy and raw materials) makes it even more difficult to consider drastic solutions, since profitability is one of the main criteria by which decisions are made in China on closing down enterprises.

5.13 In principle, administrative centralization should make it easier to implement drastic changes in industrial structure and location patterns, including if necessary shutting down or moving large enterprises. In practice, this seems not to have occurred. Inability to relocate the Fushun Aluminum Plant, whose energy consumption problems are much more serious than those of the Shenyang Smelter, suggests that the situation has not fundamentally changed (see pp. 63-65). It is particularly striking that in this case provincial authorities (for reasons of their own) advocated what was probably the appropriate course of action, relocation, while the central government refused to go along.[7/]

Importing Versus Domestic Production

5.14 NFGC potentially could play an extremely important role in carefully evaluating the relative economic costs and benefits of importing different nonferrous metals as compared with continuing or expanding domestic production. Such an analysis is sorely needed, and would appear to fall well within NFGC's assigned responsibilities. At present the choice between importing and domestic production is ad-hoc and haphazard, based primarily on short-run pressures, local interests, distorted measures of financial profitability (generated by distorted domestic prices), and strong incentives and biases toward exporting. Moreover, centralized control appears to be relatively weak and largely unable to offset distortions through administrative intervention. As a result, some obvious irrationalities in foreign trade patterns and practices for nonferrous metals have emerged. One is the continued large-

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6/ Some backward enterprises will be unable to improve and meet strong competition from outside, but those that do will become much stronger in the long run.

7/ It is of course possible that Liaoning Province was using its request that Fushun be relocated primarily as a means of bargaining with the central government to obtain more investment funds for electric power.

scale production of aluminum in areas that are deficient in electricity.[8/] Another is the desire for self-sufficiency or near self-sufficiency in key materials like copper, which is now being modified.

5.16 Drastic changes in foreign trade patterns (particularly importing rather than producing domestically) are likely to require major adjustments in production structure and enterprise structure. Unfortunately, NFGC so far appears to be unable to contemplate changes of this magnitude. The same is true of the consequence of foreign trade decisions for China's energy situation. As has already been mentioned (see p. 63), importation of electricity-intensive products like certain nonferrous metals can serve as a means of indirectly importing cheap electricity. Yet NFGC may not give appropriate emphasis to considerations like this one, or it may be overwhelmed by parochial concerns like the need to maintain employment for all workers presently in the industry.

Difficulties of Reform Implementation in a Chronic Shortage Situation

5.17 Reform implementation at the Shenyang Smelter has lagged far behind what has occurred in certain other enterprises, though in many respects the plant appears to be about average in relation to Chinese state-owned industry as a whole.[9/] In some spheres, reforms appear even to have been rolled back.[10/] There are a number of reasons for the smelter's slow progress in reform implementation, some of them specific to particular areas of operations. But the economic and strategic importance of the plant's main products and the fact that they are chronically in short supply has undoubtedly been a key factor.

5.18 In a shortage situation, government authorities have no reason to give up their control over the distribution of output and allow enterprises to engage in direct marketing. On the contrary, the perceived need for rationing to ensure that the supplies available get allocated to priority users only reinforces the tendency not to release control over sales to enterprises. The contrast with a situation of excess supply, which occurred in the case of CCWC, is striking. Commercial departments were only too happy to put the burden of responsibility for sales of clocks and to a lesser extent watches on enterprises as a means of dealing with a weak market and stemming the

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8/ The extreme example is the Fushun Aluminum Plant, for which expensive new thermal power facilities are being built to allow the enterprise to maintain production (see pp. 63-65).

9/ The sample of 20 state-owned industrial enterprises is almost certainly on average more advanced in reform implementation than Chinese state-owned industry as a whole. But within the sample, the Shenyang Smelter is undoubtedly less advanced than average.

10/ This occurred most notably in direct marketing ("self-sales") and in investment decisionmaking and financing, according to factory representatives.

catastrophic rise in inventories. Government authorities also probably saw this as the easiest means of alleviating the problem of excess supply: enterprises forced to be responsible for their sales (at least at the margin) presumably will limit production in response to market conditions. The same pattern also seems to hold for enterprises in producer goods industries facing excess supply, like the Qingdao Forging Machinery Plant.

5.19 The marketing situation of the Shenyang Smelter broadly conforms to this general pattern. Material supply authorities have forced the enterprise to market directly certain byproducts in excess supply, which has been particularly damaging since the plant has virtually no control over the amounts produced. On the other hand, byproducts in short supply (with the puzzling exception of palladium) are by and large tightly controlled, with no enterprise authority to market them directly. Sulfuric acid is the only product in short supply that the smelter is allowed to market a significant portion of itself. There are a number of possible reasons for this. Sulfuric acid is a chemical, which falls in a different category from all of the smelter's other products.[11/] Production was developed comparatively late in the history of the Shenyang Smelter (see pp. 43-44), when control via the central plan may have been relatively weak and the role of Liaoning Province (which also allocates part of the enterprise's production of sulfuric acid) was important. In any case, the authority to directly market a good chronically in short supply is clearly a privilege; granting such a privilege to enterprises does not occur easily or naturally. This is quite the opposite from what happens in a situation of excess supply.

5.20 Aside from the difficulties of reform implementation in a chronic shortage situation, there is also the question of whether reforms can be effective in such a situation. Even with substantial enterprise direct marketing, the incentives for producers to be responsive to customer needs is minimal, since they know they can always sell the goods concerned without any trouble. Certainly the actions of the Shenyang Smelter have not been oriented toward responding to non-quantitative aspects of demand, though this is in part due to the fact that it produces rather homogeneous products. On the other hand, in a situation of excess supply or rough market equilibrium, producers may become very responsive to customer needs even if the share of direct marketing in total sales is relatively small.

Incentives for Backward Integration

5.21 This case study has provided some interesting examples of how the problems of a chronic shortage situation generate strong tendencies toward backward integration. These can be entrenched or prevented by administrative demarcation of enterprises, goods, and activities. However, a fundamental

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11/ Though sulfuric acid is one of the 256 key materials subject to allocation by the State Planning Commission and State Material Supply Bureau, most producers of sulfuric acid are probably under the jurisdiction of the Ministry of Chemical Industry or lower-level chemical industry bureaus.

solution to the problem requires eliminating the shortage situation itself; once this has been done, incentives for backward integration become weaker and administrative distinctions less important.

5.22 Alloy production is a clear case of backward integration by users, which may originally have had a certain rationale in a chronic shortage situation where suppliers (smelters) could not be relied on to meet user specifications exactly and in a timely manner. Pure metals can be subjected to a simple yardstick to ensure quality, whereas this would be difficult and complicated in the case of customized alloys. Whatever its original rationale, backward integration by users was legitimized and entrenched by administrative demarcation of products which assigned alloy production to users and permitted smelters to produce only pure metals. The relative price structure makes alloy production relatively profitable, though strictly speaking it is economically almost valueless if smelters can do the same job at minimal extra cost; as a result users strive to hold onto this lucrative activity. The end result is that even enterprises willing and able to meet exacting user specifications are prevented from "entering" the alloy production field. The adverse effects of artifical barriers to entry and limited, virtually non-existent competition are obvious.

5.23 The opposite extreme is separation of upstream activities where backward integration is required to ensure supplies. The separation of the magnesium mines from the Anshan Iron and Steel Company is a good example, which also illustrates the harmful effect of biased incentives to export. Anshan would certainly have been better off if it had been allowed to retain control over the magnesium mines; this might even have been the best alternative from a national perspective, provided that exporting the magnesium products would still be permitted as an alternative to captive use by Anshan. However, the optimal solution would not necessarily involve backward integration but rather decontrol of prices and the exchange rate system to the point where trade-offs between domestic sales and exports reflect underlying economic conditions.

Problems with the Policy of Upgrading Existing Enterprises

5.24 The recent experience of the Shenyang Smelter raises questions about the wisdom of following an indiscriminate policy of technical renovation in existing enterprises, as opposed to building entirely new productive facilities. It is widely assumed that upgrading existing enterprises is far cheaper and more economically efficient than building new plants, and this is often true. But a crucial prerequisite is that the enterprise receiving the new investment and technology should be in a fundamentally sound position with respect to location, scale, material supplies, energy, etc. If this is not true, upgrading may be counterproductive, with economic costs (including externalities like pollution) far higher than those of shutting down the existing facilities and building entirely new ones.

5.25 In the case of the Shenyang Smelter, it appears to be recognized that significant new investments to increase capacity would not be appro-

priate.[12/] So the real question concerns smaller investments to conserve energy, reduce pollution, increase recovery of byproducts from ores, etc. The aggregate value of investment at the smelter has been substantial in recent years, as can be seen from Table 3.1 (p. 51). Thus in planning ahead over the medium term (5-10 years), the choice between new facilities and upgrading of existing facilities is relevant from the point of view of the amount of resources required.

5.26 The systemic obstacles in China against drastic changes in existing large and medium-sized enterprises make initial decisions on new investment projects and setting up new enterprises all the more crucial. If a factory cannot be moved or closed, it is essential that it be well-sited in the first place. But the best initial choices are likely to become inappropriate over a long period of time. The Shenyang Smelter and even the Fushun Aluminum Plant may well have been optimally located when first set up (nearly 50 years ago in the case of the former), but this is clearly no longer true. The initial investment in the smelter was very small; in essence it was inherited by the new government in 1949. But over the years, taking its initial site as given and building up capacity at the same location beyond a certain point must have become counterproductive. Thus to the extent that upgrading and expansion of existing enterprises reinforces inappropriate siting or other decisions made earlier, this approach is inferior to starting from scratch and building entirely new facilities. In any case, the alternatives should at least be carefully considered, using economic evaluation with appropriate shadow prices.

The Limitations of Organizational Reshuffling

5.27 In any process of organizational reform, there is the danger that it will degenerate into mere reshuffling of different organizations and their titles, with very little in the way of real change. There is also the possibility that organizational reforms will leave the most important relationship, that between government agencies and the enterprises they are charged with supervising, largely unchanged. The latter problem seems to have been avoided in the case of the Shenyang Smelter: removing the Shenyang Metallurgy Bureau as its immediate superior undoubtedly was an important and beneficial change.

5.28 But there are signs that organizational changes at least to some extent have involved merely reshuffling. The most obvious is the formation of NFGC from the old bureau in charge of nonferrous metals in the Ministry of Metallurgy. Similarly, the regional branch corporations have been formed largely from parts of provincial metallurgy bureaus. Under these circumstances, old organizational and personal ties may well hinder the adoption by these new organizations of their new and independent roles. This could be reinforced by the continuing need to rely on provinces and lower levels of government for a significant portion of material supplies. The danger is probably more serious for the regional branch corporations than at the central level.

12/ However, an investment project which increased copper smelting capacity by 4,000 tons per year was completed in 1982.

5.29 More generally, a strong organization is required to implement some of the major changes required in China's nonferrous metals industry. To close down or relocate large enterprises in a socialist economy, considerable administrative clout and a willingness to use it would be necessary. This is even true in some of the industrialized market economies which have been successful in adjusting their industrial structure to changing circumstances (Korea, Japan). Decisions are harder and choices are more circumscribed in dealing with declining enterprises or a deteriorating situation (such as that faced by the Shenyang Smelter), making a strong and effective administrative organization all the more important. Though there are signs that the original intention was that NFGC would be strong enough to carry out drastic changes, this has not happened so far in practice.

5.30 In any case, it is unlikely that administrative centralization alone can solve the fundamental problems faced by China's nonferrous metals industry, though this is the belief expressed in the government circular establishing NFGC. The ideal organizational form has yet to be designed and in any case is most probably a chimera. Different degrees of administrative centralization or decentralization have advantages and disadvantages, but none can escape the informational and incentive deficiencies that come with directive control over productive entities by government administrative organizations.

The Impact of Reforms

5.31 As has already been mentioned, actual reform implementation at the Shenyang Smelter has not been very advanced or unusual compared with the average for Chinese state-owned industry as a whole. Nevertheless, it is tempting to speculate on what the impact of more thoroughgoing reforms might have been on the very serious problems faced by the smelter. Would greater decision making autonomy, more access to investment funds, authority to market products directly and even to engage in alloy production, more power on labor and wages, etc. have made a great difference?

5.32 Greater freedom and more resources almost certainly would have generated better financial performance by the smelter as well as improvements in some of the technical efficiency indicators discussed earlier (see pp. __). But it is not at all clear that even the most advanced reforms being tried out in China so far would have helped greatly in alleviating the fundamental problems faced by the enterprise. This would require transcending marginal improvements in micro-level efficiency and making quantum jumps that could only result from drastic changes like relocation. But the whole orientation of Chinese industrial reforms has been in a certain sense been marginal, taking the existing enterprise structure as given. Chinese industrial reforms are not yet geared toward implementing major changes like shutting down or relocating enterprises.

5.33 The one possible exception to this general pattern is the activities of some enterprises in farming out part of production to other locations, through joint ventures and associations with other firms, or even acquiring land elsewhere and building new facilities there. The acquisition of a large plot of land from a commune and the transfer of clock production facilities to

that site by the Chongqing Clock and Watch Company is an outstanding example. In this context it is important to understand why the Shenyang Smelter has shown no signs of engaging in this kind of behavior. Is it because of technical constraints, or is it due to continuing restrictions imposed by the local government, which to a large extent appear to have been lifted in the Chongqing area? These factors were tentatively discussed in Chapter II (see pp. 24-25), but a definitive answer to this question would require more detailed study.

LIST OF REFERENCES

Byrd, William, and Tidrick, Gene. "Adjustment and Reform in the Chongqing Clock and Watch Company," in Recent Chinese Economic Reforms: Studies of Two Industrial Enterprises. World Bank Staff Working Papers, No. 652, 1984, pp. 1-69.

Chen Jiyuan, Xu Lu, Tang Zongkun, and Chen Lantong. "Management Reforms in the Qingdao Forging Machinery Plant," in Recent Chinese Economic Reforms: Studies of Two Industrial Enterprises. World Bank Staff Working Papers, No. 652, 1984, pp. 71-98.

The China Business Review. Bimonthly magazine.

"China Economic Yearbook" Editorial Committee. Zhongguo Jingji Nianjian, 1981 [1981 China Economic Yearbook]. Beijing: Jingji Guanli Zazhishe, 1981.

_____. Zhongguo Jingji Nianjian, 1983 [1983 China Economic Yearbook]. Beijing: Jingji Guanli Zazhishe, 1983.

_____. Zhongguo Jingji Nianjian, 1984 [1984 China Economic Yearbook]. Beijing: Jingji Guanli Zazhishe, 1984.

China Encyclopedia Editoral Committee. Zhongguo Baike Nianjian, 1981 [1981 China Encyclopedia Yearbook]. Beijing and Shanghai: Zhongguo Da Baike Quanshu Chubanshe, 1981.

_____. Zhongguo Baike Nianjian, 1982 [1982 China Encyclopedia Yearbook]. Beijing and Shanghai: Zhongguo Da Baike Quanshu Chubanshe, 1982.

_____. Zhongguo Baike Nianjian, 1983 [1983 China Encyclopedia Yearbook]. Beijing and Shanghai: Zhonggino Da Baike Qyanshu Chubanske, 1983.

China Materials Economics Association, editor. Zhongguo Shehui Zhuyi Wuzi Guanli Tizhi Shilue [A Brief History of China's Socialist System of Materials Management]. Beijing: Wuzi Chubanshe, 1983.

China's Customs Statistics. Quarterly journal published in Hong Kong.

Hu Changyuan and Liu Fengqian. "Jiagong Gongye Chanpin Chengben, Jiage Wenti Diaocha" [An Investigation of Production Costs and Prices for Products of Processing Industries]. Jingji Diaocha [Economic Investigations], No. 3, 1984(1), pp. 66-78.

International Financial Statistics. Monthly.

Li Rui, editor. Zhongguo Gongye Bumen Jiegou [The Subsectoral Structure of Chinese Industry]. Beijing: Zhongguo Renmin Daxue Chubanshe, 1983.

Ma Hong, chief editor. Xiandai Zhongguo Jingji Shidian [Modern China Economic Dictionary]. Beijing: Zhongguo Shehui Kexue Chubanshe, 1982.

Metal Statistics. Metallgesellschaft, AG, annual.

Metallgesellschaft, AG. Metallstatistik 1973-83 [Metal Statistics, 1973-1983]. Frankfurt: Metallgesellschaft AG, 1984.

Ministry of Coal Industry. 1982 Zhongguo Meitan Gongye Nianjian [1982 China Coal Industry Yearbook]. Beijing: Meitan Gongye Chubanshe, 1983.

Montias, J.M. "The Aggregation of Controls and the Autonomy of Subordiantes." Journal of Economic Theory, 15(2), June 1977, pp. 123-134.

Muller-Ohlsen, Lotte. Nonferrous Metals: Their Role in Industrial Development. Cambridge, England: Woodhead-Faulkner and Metallgesellschaft, AG, 1981.

Robbins, Peter. Guide to Nonferrous Metals and Their Markets. London: Kogan Page, Ltd., 1982.

Schmitz, Christopher. World Nonferrous Metal Production and Prices, 1700-1976. London: Frank Cass, 1979.

Shanghai Academy of Social Sciences. Shanghai Jingji, 1949-1982 [Shanghai's Economy, 1949-1982]. Shanghai: Shanghai Renmin Chubanshe, 1983.

Shanghai Means of Production Service Company. "Shanghai Shengchan Ziliao Jiaoyi Shichang Qingkuang Huibao" [A Report on Conditions at the Shanghai Market for the Means of Production], in China Enterprise Management Association, editor, Shanghai Gongye Qiye Jingyan [The Experience of Shanghai's Industrial Enterprises]. Shijiazhuang: Qiye Guanli Chubanshe, 1982 (2 volumes), Volume 1, pp. 47-56.

Shanghai Wuzi Shichang [Shanghai Materials Market]. Weekly newspaper published in Shanghai.

The Sixth Five-Year Plan of the People's Republic of China for Economic and Social Development (1981-1985). Beijing: Foreign Languages Press, 1984.

State Council, Legal System Bureau, editor. Zhonghua Renmin Gongheguo Fagui Huibian [Collected Laws and Regulations of the People's Republic of China]. Beijing: Legal Publishing House, 1981-1982 (reprinted from 1950s and 1960s), 13 volumes.

State Economic Commission, Enterprise Management Department. Gongye Jingying Guanli Jingyan Xuanbian, 1982 [Selections on Experience in Industrial Administration and Management, 1982]. Beijing: Renmin Chubanshe, 1983.

State Economic Commission. "Guojia Jingji Weiyuanhui Guanyu Chengli Zhongguo Youse Jinshu Gongye Zong Gongsi de Baogao (Zhaiyo)" [The State Economic Commission's Report on Establishment of the China Nonferrous Metals Industry General Corporation (draft)]. Zhonghua Renmin Gonghe Guo Guowuyuan Gongbao [Bulletin of the State Council of the People's Republic of China], 1983, No. 10 (June 20, 1983), pp.435-439.

State Statistical Bureau. Zhongguo Tongji Nianjian, 1983 [1983 China Statistical Yearbook]. Beijing: Zhongguo Tongji Chubanshe, 1983.

_____. Zhongguo Tongji Nianjian, 1984 [1984 China Statistical Yearbook]. Beijing: Zhongguo Tongji Chubanshe, 1984.

Sun Jingzhi. Zhongguo Jingji Dili Gaikuanglun [A General Economic Geography of China]. Beijing: Shangwu Yinshuguan, 1983.

United Nations. Nonferrous Metals: A Survey of their Production and Potential in Developing Countries. New York: United Nations, 1972.

World Bureau of Metal Statistics. World Metal Statistics Yearbook 1984. London: World Bureau of Metal Statistics, 1984.

Wu Yin. "Lun Woguo Xi Chanpin de Jiage Wenti" [On the Problem of Our Country's Tin Price]. Jingji Wenti Tansuo [Explorations on Economic Questions], 1982(3), pp. 41-43.

Xing Hua. "Shinian Dongluan Shiqi Caizheng Tizhi Biandong Pinfan" [Frequent Changes in the Government Finance System During the Ten Years of Turmoil]. Caizheng [Government Finance], 1983, No. 8 (August 1983), pp. 22-24, and No. 9 (September 1983), pp. 8-10.

Yan Wuhong, Chief Editor. Shanxi Jingji [Shanxi Economy]. Taiyuan: Shanxi Renmin Chubanshe, 1985.

Zhongguo Jinrong [China's Finance]. Monthly journal.

Zhou Taihe, chief editor. Dangdai Zhongguo de Jingji Tizhi Gaige [Economic System Reform in Contemporary China]. Beijing: Zhongguo Shehui Kexue Chubanshe, 1984.

Zhu Chuan, chief editor. Liaoning Jingji Tongji Nianjian, 1983 [1983 Liaoning Economic and Statistical Yearbook]. Shenyang: Liaoning Renmin Chubanshe, 1983.

STATISTICAL APPENDIX

Name of enterprise : Shenyang Smelting Plant
Date questionnaire answered: September 1983

ENTERPRISE MANAGEMENT STUDY QUESTIONNAIRE

Quantitative Data

Item	Units	1975	1976	1977	1978	1979	1980	1981	1982
I. Production									
1. Gross value of industrial output (at 1970 prices)	Y 10,000	46,049	47,116	40,502	47,866	50,376	55,342	53,825	52,847
2. Gross value of industrial output (at current prices)	Y 10,000	-	47,116	43,024	50,690	53,894	66,251	69,728	68,439
3. Net value of industrial output (at current prices)	Y 10,000	-	6,843	5,652	6,817	8,387	9,684	9,647	9,390
4. Physical output of main industrial commodities produced									
a. Electrolytic copper	ton	45,616	47,285	36,315	46,154	50,242	56,547	51,938	48,654
b. Electrolytic lead	ton	48,200	51,433	50,563	47,808	47,377	51,489	55,024	57,253
c. Electrolytic zinc	ton	20,026	17,612	16,134	20,727	21,513	17,691	17,723	17,235
5. Value of output of main industrial commodities produced (in current prices)									
a. Electrolytic copper	Y 10,000	25,089	26,007	19,973	25,385	27,633	31,116	28,560	26,760
b. Electrolytic lead	Y 10,000	10,272	10,951	10,768	10,183	10,091	10,967	11,720	12,195
c. Electrolytic zinc	Y 10,000	3,548	3,116	3,065	3,662	3,856	3,169	3,194	3,082
II. Labor Force									
6. Total wage bill	Y	5,026,197	5,068,627	5,111,144	5,636,278	6,580,735	7,334,965	7,948,908	7,511,055
Of which: Time-rate wages	Y	4,274,354	4,287,047	4,322,213	4,571,284	4,395,291	4,030,186	2,898,841	4,499,910
Piece-rate wages	Y	-	-	-	20,090	94,822	812,081	2,039,042	241,682
Overtime wages	Y	44,030	71,866	83,617	206,113	241,237	303,169	202,127	142,974
Supplementary wages	Y	425,406	415,438	404,900	269,076	507,047	319,601	245,676	228,842
Subsidies	Y	282,407	294,276	300,416	370,511	403,342	759,333	774,823	724,445
Bonuses charged to production costs	Y	-	-	-	-	191,068	174,573	169,581	314,886
7. Total bonuses	Y	-	-	-	219,024	912,299	1,104,380	1,787,799	1,668,948
Of which: Charged to production costs	Y	-	-	-	-	191,068	174,573	169,581	314,886
Drawn from retained profits	Y	-	-	-	-	-	929,807	1,618,218	1,354,062
8. Labor insurance and welfare expenditure for workers and staff	Y 10,000	161	191	283	245	444	977	686	399
Breakdown by type:									
Labor insurance expenditures	-	-	-	-	-	-	-	-	-
Collective welfare facilities (housing, cafeterias, bathhouses, day care centers, etc.)	Y 10,000	38	67	155	114	121	671	438	189
Of which: Expenditures for capital construction of nonproductive assets	-	-	-	-	-	-	-	-	-
Individual collective welfare benefits (subsidies for bath, haircut, transportation, etc.)	Y 10,000	59	59	59	55	58	55	58	79
Other /a	Y 10,000	-	-	-	-	89	-	-	-
Breakdown by source of financing:									
Charged to production costs in accordance with regulations (11% of standard wages)	Y 10,000	53	56	54	57	-	-	-	-
Drawn from retained profits	Y 10,000	-	-	-	-	144	153	154	103
Other /b	Y 10,000	11	9	15	19	32	98	36	28
9. Total number of workers and staff (average during the year)	persons	5,924	6,100	6,208	6,301	6,255	6,250	6,441	6,770
a. Regular workers (average during the year)	persons	4,275	4,352	4,392	4,342	4,206	4,072	4,015	4,161
b. Temporary workers (average during the year)	persons	-	40	85	84	5	-	-	-
c. Apprentices (average during the year)	persons	23	49	28	6	42	104	109	100
d. Engineers and technicians (average during the year)	persons	382	378	372	374	384	372	403	420
e. Managerial and administrative personnel (average during the year)	persons	691	698	702	727	799	916	1,026	1,155
f. Leading cadres	persons	13	13	11	11	15	15	15	13
g. Service personnel (average during the year)	persons	418	441	497	591	470	570	678	758
h. Other staff (average during the year) /c	persons	122	129	121	167	334	219	195	163

Item	Units	1975	1976	1977	1978	1979	1980	1981	1982
10. Average wages and total bonuses (including bonuses from all sources) per employee	Y/year	848	831	823	898	1,052	1,174	1,234	1,109
Of which:									
Average basic wage	Y/year	722	703	696	727	712	736	720	696
Average total bonus	Y/year	-	-	-	35	146	176	278	247
Average other income	-	-	-	-	-	-	-	-	-
a. Regular workers									
Average basic wage / Average total bonus	Y/year	-	-	-	-	-	935	1,023	951
b. Temporary manual workers									
Average basic wage / Average total bonus	Y/year	-	-	-	-	-	-	-	-
c. Apprentices									
Average basic wage / Average total bonus	Y/year	-	-	-	-	-	413	453	477
d. Engineers and technicians									
Average basic wage / Average total bonus	Y/year	-	-	-	-	-	915	1,031	1,005
e. Managerial and administrative personnel									
Average basic wage / Average total bonus	Y/year	-	-	-	-	-	1,023	1,091	1,053
f. Leading cadres of the enterprise									
Average basic wage / Average total bonus	Y/year	-	-	-	-	-	1,794	1,971	1,692
g. Service personnel									
Average basic wage / Average total bonus	Y/year	-	-	-	-	-	847	915	887
h. Other staff									
Average basic wage / Average total bonus	Y/year	-	-	-	-	-	561	492	564
III. Fixed Assets									
11. Original value of fixed assets at year-end	Y 10,000	10,862	11,369	13,878	15,995	15,615	17,018	17,452	17,777
Breakdown by type of asset:									
Nonproductive fixed assets	Y 10,000	1,714	1,719	1,728	2,311	2,513	3,186	3,629	3,610
Of which: Housing	Y 10,000	-	-	-	-	1,759	2,159	2,584	2,798
Productive fixed assets	Y 10,000	9,001	9,572	12,072	13,606	12,780	13,499	13,461	13,615
Of which: Machinery and equipment	Y 10,000	-	-	-	-	9,825	10,702	10,432	10,281
Buildings	Y 10,000	-	-	-	-	2,892	2,730	2,953	3,273
Other /d	Y 10,000	-	-	-	-	63	67	76	61
12. Net value of fixed assets at year-end	Y 10,000	2,901	2,862	4,795	6,240	6,239	6,842	7,087	7,174
13. Original value of fixed assets sealed up in storage (fengcun)	-	-	-	-	-	-	-	-	-
IV. Circulating Assets									
14. Total value of quota circulating assets at year-end	Y 10,000	12,852	11,282	9,966	9,723	11,839	13,855	12,025	11,221
Of which: Inputs (reserve fund)	Y 10,000	8,234	6,212	4,765	4,235	5,857	7,952	7,126	6,330
Goods in process (production fund)	Y 10,000	4,289	4,445	4,799	4,983	5,502	5,503	4,401	4,586
Outputs (final products)	Y 10,000	329	625	402	505	480	400	498	305
15. Total value of nonquota circulating assets at year-end	Y 10,000	1,117	94	846	396	163	667	421	295
Of which: Cash	Y	2,019.56	3,660.44	1,596.92	971.04	1,599.55	1,450.85	1,861.18	2,135.21
Bank deposits	Y 10,000	1,117	94	846	396	163	667	421	295
Other	-	-	-	-	-	-	-	-	-
16. Receivables at year-end	Y 10,000	1,596	1,042	454	588	663	1,339	712	426
Of which: Receivables for goods shipped	Y 10,000	1,418	776	346	483	563	1,093	495	262
Installment payments	-	-	-	-	-	-	-	-	-
Payments made in advance for goods	-	-	-	-	-	-	-	-	-
Other	Y 10,000	178	266	108	105	100	246	217	164
Payables at year-end	Y 10,000	2,845	818	500	796	1,127	756	737	340
Of which: Payments owed for goods delivered	Y 10,000	2,738	638	284	300	777	148	26	2
Payments owed to Finance Bureau	Y 10,000	-	-	-	129	-	378	200	-
Advanced payments received for goods	Y 10,000	-	-	13	83	246	65	144	12
Internal transactions	-	-	-	-	-	-	-	-	-
Other	Y 10,000	107	180	203	284	104	165	367	326

Item	Units	1975	1976	1977	1978	1979	1980	1981	1982
V. Investment									
17. Total capital construction investment (current prices)	Y 10,000	-	-	-	-	-	35	170	-
a. Breakdown by type of investment									
Civil construction	-	-	-	-	-	-	-	-	-
Machinery, equipment, implements	Y 10,000	-	-	-	-	-	35	170	-
Other	-	-	-	-	-	-	-	-	-
b. Breakdown by source of financing									
State budget appropriations	Y 10,000	-	-	-	-	-	35	20	-
Capital construction loans	-	-	-	-	-	-	-	-	-
Enterprise's own funds	Y 10,000	-	-	-	-	-	-	150	
Grants from local government	-	-	-	-	-	-	-	-	-
Loans from local government	-	-	-	-	-	-	-	-	-
Grants from other organizations	-	-	-	-	-	-	-	-	-
Loans from other organizations	-	-	-	-	-	-	-	-	-
18. Investment for renewal and modernization of fixed assets	Y 10,000	863	919	960	956	1,177	1,990	2,234	1,733
a. Breakdown by type of investment									
Civil construction	Y 10,000	-	-	-	-	870	1,643	1,998	1,543
Machinery, equipment, implements	Y 10,000	-	-	-	-	307	349	236	190
Other	-	-	-	-	-	-	-	-	-
b. Breakdown by source of financing									
State budget appropriations	Y 10,000	198	-	230	-	360	246	150	-
Enterprise-retained profits	Y 10,000	-	-	-	-	-	82	254	461
Enterprise basic depreciation funds	Y 10,000	456	579	222	560	325	1,168	1,015	774
Enterprise major repair funds	Y 10,000	209	290	378	396	492	496	769	441
Other funds belonging to the enterprise /a	Y 10,000	-	50	130	-	307	480	393	743
Grants from local government	Y 10,000	-	-	-	-	-	-	-	50
Loans from local government	-	-	-	-	-	-	-	-	-
Short- and medium-term loans for equipment purchase (total)	Y 10,000	-	-	-	-	-	-	45	120
Of which:									
From People's Bank of China	Y 10,000	-	-	-	-	-	-	45	120
From People's Construction Bank of China	-	-	-	-	-	-	-	-	-
From Bank of China	-	-	-	-	-	-	-	-	-
From other banks	-	-	-	-	-	-	-	-	-
From other organizations	-	-	-	-	-	-	-	-	-
Other sources of financing	-	-	-	-	-	-	-	-	-
VI. Fixed Investment Loans									
19. Total amount borrowed in each year	-	-	-	-	-	-	-	-	-
From the People's Bank of China	Y 10,000	-	-	-	-	-	-	45	120
From the People's Construction Bank of China	-	-	-	-	-	-	-	-	-
From the Bank of China	-	-	-	-	-	-	-	-	-
From other banks	-	-	-	-	-	-	-	-	-
From the local government	-	-	-	-	-	-	-	-	-
From a local trust and investment corporation	Y 10,000	-	-	-	-	-	-	-	160
From other organizations	-	-	-	-	-	-	-	-	-
VII. Financial Indicators									
21. Total revenues from sales of products (at curent prices)	Y 10,000	43,662	45,890	39,458	46,724	49,565	53,793	57,080	60,262
22. Total costs of same	Y 10,000	40,337	42,644	37,099	43,585	45,270	48,397	51,489	55,231
Of which: Production costs	Y 10,000	37,518	39,740	34,540	40,740	42,294	45,357	48,247	51,710
Marketing costs	-	-	-	-	-	-	-	-	-
Taxes	Y 10,000	2,819	2,904	2,557	2,845	2,976	3,040	3,242	3,421
23. Net profits from sales of commodities (21 minus 22)	Y 10,000	3,325	3,246	2,359	3,138	4,296	5,396	5,591	5,131
24. Net profits from economic activities other than commodity sales	Y 10,000	-3	5	8	-21	-46	-	-28	-8
25. Net expenditures on nonprofit activities	Y 10,000	104	101	97	1,241	48	64	147	88
26. Administrative profits (23 plus 24 minus 25)	Y 10,000	3,217	3,150	2,270	1,876	4,305	5,332	5,416	5,035
27. Distribution of administrative profits									
a. Repayment of bank loans for fixed investment	-	-	-	-	-	-	-	-	-
b. Remitted to higher levels	Y 10,000	3,201	3,183	2,379	1,577	4,008	4,529	4,500	4,070
c. Tax payments (other than those in no. 22)	-	-	-	-	-	-	-	-	-
d. Fee for state-owned fixed assets	-	-	-	-	-	-	-	-	-
e. Fee for state-owned circulating assets	Y 10,000	-	-	-	-	-	-	236	236
f. Retained by enterprise	Y 10,000	-	-	-	28	300	428	391	390
[illegible]	-	-	-	-	-	-	-	-	-

Item	Units	1975	1976	1977	1978	1979	1980	1981	1982
28. Uses of enterprise retained profits									
Total profits retained by enterprise during the year	Y 10,000	-	-	-	28	300	428	391	390
Used for production development expenditures	Y 10,000	-	-	-	-	-	82	106	261
Used for worker's labor insurance and welfare expenditure	Y 10,000	27	32	33	40	100	199	136	163
Used for worker's bonuses	-	-	-	-	-	67	86	110	141
Used for other purposes	-	-	-	-	-	-	-	-	-
29. Basic depreciation funds generated during the year	Y 10,000	517	546	575	673	775	835	921	936
Of which: Retained by enterprise	Y 10,000	517	496	545	389	388	521	461	468
VIII. Planning									
30. Annual gross output value									
a. Initial planned value	Y 10,000	45,820	42,500	33,250	32,585	34,840	45,070	49,000	54,900
Date initial plan promulgated	date	04/12	02/21	01/03	02/14	02/28	02/25	02/11	01/21
b. Final planned value	Y 10,000	49,680	42,500	33,250	49,200	49,565	49,195	52,000	69,960
Exact date final plan determined	date	04/12	02/21	01/03	04/19	02/28	02/28	06/08	05/07
c. Actual result /f	Y 10,000	56,433	57,712	51,435	61,391	63,850	70,555	69,915	68,645
31. Annual total profits									
a. Initial planned value	Y 10,000	3,200	3,100	2,400	4,160	2,055	3,330	4,960	5,429
Date initial plan promulgated	date	04/28	03/02	02/15	02/14	02/28	02/25	06/08	05/07
b. Final planned value	Y 10,000	3,200	3,100	2,400	2,800	2,500	3,525	4,966	5,429
Exact date final plan determined	date	04/28	03/02	02/15	04/19	02/28	02/25	06/08	05/07
c. Actual result	Y 10,000	3,217	3,150	2,270	1,876	4,305	5,332	5,416	5,035
32. Profits handed over to higher levels									
a. Initial planned value	Y 10,000	-	-	-	-	-	3,003	4,350	4,809
Date initial plan promulgated	date	-	-	-	-	-	03/25	02/11	05/07
b. Final planned value	Y 10,000	-	-	-	-	-	3,180	4,517	4,809
Exact date final plan determined	date	-	-	-	-	-	02/25	06/08	05/07
c. Actual result /f	Y 10,000	3,172	3,183	2,379	1,577	4,008	4,591	4,735	4,370
33. Physical output of main products									
A. Electrolytic copper									
a. Initial planned value	Y 10,000	4,600	41,500	22,000	22,000	25,000	45,000	52,200	33,600
Date initial plan promulgated	date	04/12	02/21	01/03	02/14	02/28	02/25	02/11	01/21
b. Final planned value	Y 10,000	51,000	41,500	22,000	50,000	50,000	51,000	51,700	51,200
Exact date final plan determined	date	05/12	02/21	01/03	04/19	04/18	03/25	06/08	05/07
c. Actual result	Y 10,000	45,616	47,285	36,315	46,154	50,242	56,574	51,938	48,654
B. Electrolytic lead									
a. Initial planned value	Y 10,000	50,000	46,000	49,000	45,500	45,000	43,600	49,000	43,000
Date initial plan promulgated	date	04/12	02/21	01/03	02/14	02/28	02/25	02/11	01/21
b. Final planned value	Y 10,000	51,000	46,000	49,000	47,000	47,000	44,800	51,500	57,000
Exact date final plan determined	date	05/12	02/21	01/03	04/19	04/18	03/25	06/08	05/07
c. Actual result	Y 10,000	48,280	51,433	50,563	47,808	47,377	51,489	55,024	57,255
C. Electrolytic zinc									
a. Initial planned value	Y 10,000	21,000	20,000	20,000	20,000	20,000	16,000	18,000	16,000
Date initial plan promulgated	date	04/12	02/21	01/03	02/14	02/18	02/25	02/11	01/21
b. Final planned value	Y 10,000	21,000	20,000	20,000	20,000	20,000	16,000	18,000	17,800
Exact date final plan determined	date	05/12	02/21	01/03	04/19	04/18	03/25	06/08	05/07
c. Actual result	Y 10,000	20,026	17,612	16,134	20,727	21,513	17,691	11,723	17,235
IX. Input Consumption									
34. Ratios of material input consumption to output produced of major commodities									
a. Electrolytic copper	ton	1,034	1,033	1,033	1,031	1,031	1,031	1,030	1,030
b. Electrolytic lead	ton	1,099	1,094	1,103	1,073	1,063	1,062	1,061	1,058
c. Electrolytic zinc	ton	1,058	1,058	1,058	1,045	1,043	1,041	1,039	1,038
35. Energy consumption									
Total consumption of electricity during year	10,000 kWh	16,022	15,598	14,997	17,415	17,746	17,083	17,489	17,684
Of which: Power consumed in industrial production	10,000 kWh	15,425	15,084	14,394	16,810	17,113	16,873	17,201	17,448
Total consumption of coal during year	ton	14,621	5,636	5,726	3,397	10,584	22,971	30,495	41,965
Total consumption of fuel oil during year	ton	36,773	33,333	33,445	34,442	33,113	27,159	25,902	25,297
36. Amount of electricity consumed per unit of output of major products									
a. Electrolytic copper	kWh/ton	259	260	259	251	257	269	265	224
b. Electrolytic lead	kWh/ton	193	195	206	191	183	174	152	145
c. Electrolytic zinc	kWh/ton	3,715	3,793	3,879	3,680	3,650	3,670	3,680	3,733
37. Amount of coal consumed per unit of output of major products	-	-	-	-	-	-	-	-	-

Item	Units	1975	1976	1977	1978	1979	1980	1981	1982
38. Amount of fuel oil consumed per unit of output of major products									
a. Electrolytic lead	kg/ton	46	65	74	60	58	57	51	44
b. Electrolytic zinc	kg/ton	-	39	40	33	33	30	30	33
X. Inventories									
39. Year-end inventories of major outputs									
a. Electrolytic copper	ton	196,446	590,744	784,450	648,840	635,637	345,991	325,890	292,648
b. Electrolytic lead	ton	435,971	1,248,287	255,667	413,906	394,170	576,995	1,161,938	110,856
c. Electrolytic zinc	ton	281,988	499,537	355,339	512,823	811,311	181,829	512,447	447,612
40. Year-end inventories of major inputs									
a. Coal	ton	789	104	342	201	5,210	6,677	2,824	6,019
b. Fuel oil	ton	1,119	3,313	1,193	568	3,945	3,392	2,796	5,404
c. Steel	ton	549	804	718	829	817	1,036	856	849
XI. Exports									
41. Total export of main products	-	-	-	-	-	-	-	-	-
XII. Production Costs									
42. Percentage change in production cost of comparable products									
a. Electrolytic copper ore (?)	Y	4,721.89	4,729.23	4,826.78	4,768.45	4,169.78	4,791.90	4,811.05	4,836.44
b. Electrolytic lead ore (?)	Y	1,885.75	1,898.93	1,924.64	1,882.04	1,852.24	1,863.82	1,828.81	1,793.22
c. Electrolytic zinc	Y	1,531.35	1,575.13	1,570.85	1,528.03	1,477.14	1,588.64	1,569.09	1,652.21
XIII. Housing Allocated by the Enterprise									
43. Family housing									
Total floor space /g	sq m	90,217.20	95,574.20	98,333.15	112,565.15	115,565.15	134,825.16	146,535.16	157,685.16
Number of families living in this type of housing	no.	3,104	3,237	3,315	3,676	3,748	4,164	4,411	4,671
44. Dormitories for individuals									
Total floor space	sq m	3,158	3,158	3,158	3,158	2,598	2,598	2,598	2,598
Number of workers living in this type of housing	no.	195	190	235	270	280	310	357	186

/a Staff and workers' club.

/b For 1975-78, from farm, guest house, housing and services; for 1979-82, from sanitorium, wage subsidy (?), payments from visitors (for room and board, etc.), prizes given up by staff and workers.

/c Including personnel on long-term study leave or sick leave, and personnel engaged in agricultural and sideline production.

/d Projector, camera, typewriter, printing equipment, typecasting equipment, cold water container, environmental protection equipment, computer, (??), farm, cafeteria, televisions, washing machines.

/e Tax for sulphuric acid exempted and used for waste treatment.

/f According to 1980 constant prices.

/g Building area; including bathroom (WC), kitchen, corridor, stairway, etc.

The World Bank

Headquarters
1818 H Street, N.W.
Washington, D.C. 20433, U.S.A.

Telephone: (202) 477-1234
Telex: WUI 64145 WORLDBANK
RCA 248423 WORLDBK
Cable Address: INTBAFRAD
WASHINGTONDC

European Office
66, avenue d'Iéna
75116 Paris, France

Telephone: (1) 723-54.21
Telex: 842-620628

Tokyo Office
Kokusai Building
1-1 Marunouchi 3-chome
Chiyoda-ku, Tokyo 100, Japan

Telephone: (03) 214-5001
Telex: 781-26838

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