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Perspectives on the International Competitive  
Position of the U.S. Steel Industry

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Abstract

This paper reviews the decline in the U.S. steel industry during the past three decades and relates this decline to changes in the industry's international competitive position. The paper also provides a review of trade policy in the area of steel since the late 1960s, and concludes that the decline in the U.S. steel industry occurred in spite of some form of protection against imports almost continuously since 1969. The paper concludes by contrasting the decline in the importance of the integrated U.S. firms with the emergence of a new, highly competitive class of U.S. steel producers, known as "mini-mills".

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## I. Introduction

During the decade following the Second World War, the U.S. steel industry enjoyed a degree of technological superiority over its international competitors that made it the world's dominant producer of steel. In 1955 the United States accounted for roughly 40 percent of the world supply of steel and imported only 1 percent of its domestic consumption; at the same time, the steel industry accounted for close to 1 percent of total civilian employment in the United States. By 1985, however, the U.S. steel industry produced only 11 percent of the world's steel; more than 25 percent of U.S. consumption was imported; and less than 1/5 of 1 percent of total civilian employment in the United States was accounted for by the steel industry.

This paper reviews these developments and relates them to changes in factors that have altered the international competitive position of the U.S. steel industry, such as changes in wages, profitability, and technology. A review of U.S. trade policy in the area of steel is also provided, together with a survey of estimates of the impact of some of these policies during the period 1969-74. The paper concludes with a summary of the characteristics of a highly competitive class of new firms--known as "mini-mills"--which have emerged in the U.S. steel industry in recent years.

## II. Historical Developments

Following two decades of rapid growth, world production of steel slowed markedly during the 1970s, before falling by almost 14 percent in the period 1979-82 (see following tabulation). After increasing a little in 1983, world output rose sharply in 1984 before slowing again in 1985; in that year, world output remained well below the peak registered in 1978.

Several factors have contributed to these changes in the trend in world steel production. The annual growth of real GNP in industrial countries, which averaged about 5 percent during the 1960s, declined to 3 1/4 percent during the decade of the 1970s and to 2 percent during the six years ended 1985. In addition, steel has lost its share of markets where qualities such as weight reduction, malleability, and corrosion resistance are considered important. Other products (such as plastics, aluminum, and fiberglass) have made significant inroads into many of steel's traditional markets, reflecting in particular efforts to improve the fuel efficiency of automobiles following the large increases in real energy prices over the period 1973-84. <sup>1/</sup>

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<sup>1/</sup> For example, the Ford Motor Company is reported to have reduced the steel content of its average car by over 30 percent from 1977 to 1982 (Forbes, November 22, 1982). By contrast, over the same period that company's use of plastics and aluminum per car rose by 35 and 20 percent, respectively.

Since the early 1950's, steel production in the United States has diverged markedly from the trends in worldwide production (see following tabulation). During the two decades prior to 1970, production of steel by U.S. firms increased at an average rate of 1 1/2 percent a year compared with annual increases of 16 percent in Japan, 10 percent for the developing countries, and 5 1/2 percent in the European Community (EC). As a result, the U.S. share of the world market fell from 47 percent in 1950 to 20 percent two decades later. Since 1970 U.S. production has declined by approximately 35 percent compared with growth in world steel production of about 21 percent, and the U.S. share of the world market fell further to 11 percent by 1985.

World Production of Raw Steel <sup>1/</sup>

	<u>Total</u>	<u>United States</u>	<u>European Community</u>	<u>Japan</u>	<u>Other Industrial Countries</u>	<u>Developing Countries</u>	<u>Non-Market Economies</u>
(Percentage distribution)							
1950	100	47	26	3	4	2	19
1960	100	26	28	6	5	3	31
1970	100	20	23	16	6	5	30
1980	100	14	18	16	7	10	36
1983	100	12	17	15	7	11	39
1984	100	12	17	15	7	12	38
1985	100	11	17	15	6	12	38

(Percentage changes, at annual rate)

1951-60	6.3	0.3	7.3	16.5	9.2	10.2	11.5
1961-70	5.5	2.8	3.5	15.5	7.5	9.6	5.2
1971-75	1.7	-2.4	-1.9	1.9	3.5	8.6	4.9
1976-80	2.1	-0.8	0.4	1.7	2.1	10.8	2.6
1981-85	--	-4.6	-1.1	-1.1	0.1	4.6	1.3
1980	-4.1	-18.0	-9.0	-0.3	-1.8	3.6	1.1
1981	-1.4	8.1	-1.1	-8.7	-3.3	-1.3	-1.8
1982	-8.8	-38.3	-11.8	-2.1	-9.0	2.9	-0.4
1983	2.8	13.5	-1.7	-2.4	1.8	3.7	4.0
1984	7.0	9.4	9.7	8.3	9.8	10.9	3.1
1985	1.2	-4.6	0.5	0.3	1.1	8.1	1.7

In the domestic market, U.S. steel producers also have lost considerable ground to imports. Imported steel, which in 1955 accounted for 1 1/4 percent of the apparent supply of steel in the United

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<sup>1/</sup> Source: American Iron and Steel Institute, Annual Statistical Report.

States, 1/ has increased fairly steadily since then (see tabulation below). During the two decades prior to 1970, the EC was generally the major foreign supplier to the United States. However, Japan, which captured much of the growth of the U.S. market during the 1960s, became the largest supplier around 1970. In recent years, the share of the U.S. market accounted for by developing countries (particularly Brazil and the Republic of Korea) also has increased substantially.

U.S. Imports of Steel Mill Products by Country 2/

(As percent of apparent supply)

	<u>Total</u>	<u>Japan</u>	<u>European Community</u>	<u>Developing Countries</u>	<u>Other</u> <u>3/</u>
1955	1.2	0.1	0.8	--	0.3
1960	4.7	0.8	3.2	0.1	0.6
1965	10.4	4.4	4.9	0.2	0.9
1970	13.8	6.1	5.6	0.6	1.5
1975	13.5	6.6	4.6	0.6	1.7
1980	16.3	6.3	4.1	2.4	3.5
1981	18.9	5.9	6.1	2.5	4.4
1982	21.8	6.8	7.3	3.6	4.1
1983	20.5	5.1	4.9	5.9	4.6
1984	26.4	6.7	6.4	6.3	7.1
1985	25.2	6.2	7.2	5.3	6.0

III. The Trade Policy Environment: 1968-86

As the share of imports surged during the 1960s, concern mounted in the United States regarding the impact of this development on the domestic steel industry. 4/ In an effort to forestall action by the U.S. Congress to impose quotas, in the summer of 1968 the Federal Republic of Germany and Japan proposed restraints on their steel exports to the United States. Formal agreement was quickly reached on three-year

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1/ Apparent supply is defined as net shipments plus imports minus exports; it differs from actual supply because of changes in inventories.

2/ Source: American Iron and Steel Institute, Annual Statistical Report.

3/ Industrial countries other than Japan and the EC, plus non-market economies.

4/ Prior to 1959--a year which featured an extended strike in the U.S. steel industry--imports were negligible; nevertheless, tariffs averaged 6-8 percent of the value of imports. Nontariff barriers to steel trade were not an important factor in trade policy until the late 1960s.

"Voluntary Restraint Agreements" (VRAs), <sup>1/</sup> which were later extended in a modified form for another three years. These arrangements were allowed to expire at the end of 1974 reflecting the world-wide boom in steel in 1973-74, the devaluation of the U.S. dollar, and U.S. price controls. It is notable that during the period when the VRAs were in operation, the volume of steel imports exceeded the ceiling in only one year (1971), but there was a marked change in the mix of imports toward high valued products.

A survey of estimates of the impact of these VRAs is provided in the following tabulation. The estimates, which cover a broad range of possible outcomes, must be heavily qualified in view of their limitations. <sup>2/</sup> According to these estimates, the VRAs lowered average annual imports of steel by 3 to 9 million net tons, beginning with a relatively small impact in the early years of the agreements. The estimated range of price increases associated with the VRAs is even wider--from 1 1/2 to 14 percent of domestic prices. The estimates of employment effects, which mainly reflect different output and inter-sectoral feedback effects, range from 19 to 58 thousand man-years annually.

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<sup>1/</sup> These agreements, which took effect from January 1, 1969, limited imports from both Japan and the EC to 5.75 million net tons for 1969, and allowed for 5 percent annual growth in the quotas. By way of comparison, in 1968 imports from Japan and the EC had been 7.3 and 7.4 million net tons, respectively.

<sup>2/</sup> For example, none of the results incorporate feedback effects from other countries and inter-sectoral effects are usually excluded. More generally, these studies do not take into account the effect of the VRA's on the efficiency of resource allocation. In addition, different results can often be traced to certain crucial differences related to empirical issues (for instance, different estimates of the pass through from import to domestic steel prices) on which various models may differ.

Effects of Voluntary Restraint Agreements 1/

	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
	<u>(Millions of net tons)</u>					
<u>Imports of steel</u>						
Tsao	-2.9	-4.4	-5.2	-1.5	-1.0	-4.1
Jondrow	-3.3	-4.1	-9.2	-10.2	-7.2	...
Takacs	-5.8	-8.0	-10.9	-8.4	-7.7	-12.9

(In percent)

Domestic steel prices

Tsao	5.3	5.7	5.3	1.7	1.3	3.6
Jondrow	14.3	14.3	15.4	12.3	13.1	13.4
Crandall	...	...	1.2-3.5	1.2-3.5	...	...

(Thousands of man-years)

Domestic employment

Tsao	1.7	17.3	55.2	9.4	2.9	28.2
Jondrow	16.5	39.0	34.1	90.0	109.3	...

Following the end of the VRAs in 1974 and the drop in world demand for steel resulting from the recession in the mid-1970s, the import share of the U.S. steel industry began to rise again. In response, import controls on specialty steel were imposed in 1976. 2/ This was followed in 1977 by the Solomon Plan--the first attempt to develop a comprehensive set of policies to reverse the deteriorating prospects of the U.S. steel industry. 3/ Although this plan suggested policy changes in several areas (including tax policy, antitrust legislation, environmental regulations and research and development), its centerpiece was the so-called "trigger price mechanism" (TPM). In broad terms, the aim of the TPM was to ensure that imported steel was not dumped on the U.S. market, while avoiding lengthy legal proceedings. To this end, the TPM set a price floor determined by Japanese costs (which were assumed to be the lowest in the world) plus an 8 percent profit margin; steel entering

1/ Sources: Tsao (1982), Jondrow (1978), Takacs (1975), and Crandall (1981). Figures in the tabulation indicate changes with respect to levels that would have prevailed in the absence of the restraints.

2/ On January 17, 1976, the U.S. International Trade Commission proposed a limit of 146,000 net tons per year on imports of stainless steel and alloy tool steel; quotas were subsequently imposed for a three-year period beginning June 14, 1976.

3/ See Solomon (1977).

the U.S. market at prices below this trigger point was, in principle, subject to an immediate anti-dumping investigation.

By the late 1970s, American steelmakers had become disillusioned with the effectiveness of the TPM, and in 1980 U.S. Steel initiated legal action against a broad range of foreign exporters--an action which, the Government had stressed, would lead to termination of the TPM. Initially, the TPM was strengthened and U.S. Steel's suits were withdrawn. However, when steel imports surged again in 1981, domestic producers began filing wide-ranging complaints against dumping and subsidies, alleging that producers in several countries would not be competitive in the U.S. market without significant government transfers.

Several of the complaints that were filed during the early 1980s were settled by the negotiation of bilateral agreements. In October 1982, the United States and the EC concluded two agreements (one concerning carbon steel mill products and the other pipes and tubes) 1/ establishing separate import penetration ratios for individual products covering the period November 1982 to December 1985. Other bilateral arrangements were reached, including one with Mexico in April 1984 and one with South Africa in May 1984. In response to each of these agreements, industry complaints alleging dumping and subsidies were withdrawn. In July 1983, the President provided new protection to specialty steel producers in the form of duty increases and global quotas on certain products for a four-year period. This protection, which was granted under the escape clause provision, 2/ was similar to the relief that had been given to the specialty steel industry beginning in June 1976.

In January 1984, U.S. carbon steel producers filed a new request for escape clause relief from imports. The International Trade Commission (ITC) found that the industry had been injured by imports and recommended that tariffs be raised on a number of steel products and that imports of other steel products be limited to their respective

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1/ Taken together the two agreements covered about 90 percent of the EC's steel exports to the United States.

2/ Under the escape clause provision, the President has authority (provided by Sections 201-3, Trade Act of 1974, as amended) to grant temporary import relief for a domestic industry if imports are judged to be a substantial source of injury to domestic producers. It is the function of the International Trade Commission to investigate requests for protection, and if certain conditions are met, to recommend to the President the type of import protection (including the imposition of duties, tariff-rate quotas, quantitative import restrictions, and orderly marketing arrangements) that it considers appropriate. The President makes the final decision whether import relief should be granted and the form that it should take. If the ITC recommends relief and the President rejects the recommendation, the Congress (by concurrent resolution of both Houses) can order that the recommendation be put into effect.



average market shares in the 1979-81 period. In September 1984, the President rejected the ITC's recommendations and announced an alternative program that sought to limit steel imports to 18 1/2 percent of U.S. consumption, compared with an import share of 25 percent in the first half of 1984.

Under the President's program, VRAs would be negotiated with major steel exporters to the United States with the exceptions of the EC (which, as noted above, was already subject to a VRA) and Canada. Once the agreements were signed, the numerous antidumping and subsidy complaints filed by the U.S. industry would be withdrawn and U.S. steel producers agreed not to file new complaints as long as the VRAs were in effect. The President's plan also called for: continued rigorous enforcement of U.S. unfair trade laws (including initiation of unfair trade cases by the Commerce Department and the Office of the U.S. Trade Representative); discussions with U.S. trading partners to liberalize steel trade; and, monitoring of the domestic industry's efforts to adjust. As regards this final provision, U.S. companies were required to reinvest "substantially" all of their net cash flow from steel operations into the modernization of their industry, and to commit at least 1 percent of their net cash flow to retraining displaced workers.

In December 1984, it was announced that VRAs covering the five-year period from October 1984 to September 1989 had been negotiated with Australia, Brazil, Japan, the Republic of Korea, Mexico, South Africa, and Spain. Subsequently, additional agreements were concluded with Czechoslovakia, Finland, Poland, and Romania. During 1985, a revised agreement with the EC on finished steel was finalized to extend the earlier arrangement and to bring it into conformity with the other VRAs that had been negotiated. <sup>1/</sup> However, an understanding on EC exports of semi-finished steel was not reached, and the United States unilaterally imposed a limit on such imports in January 1986 after claiming that the EC was circumventing its VRA on finished steel by overshipping semi-finished products.

During the course of 1986, this dispute in the area of semi-finished steel tended to spill over into other sectors. In retaliation for the U.S. restrictions on semi-finished steel, in January 1986 the EC imposed quotas on U.S. exports of fertilizer, tallow, and coated paper. In June, agreement in principle was reached for resolving the dispute, but implementation was delayed because of a dispute within the EC about how to share the export quotas, which extended through 1989. This dispute was subsequently resolved, and effective September 13, 1986, EC producers were allowed to export 800,000 short tons of semi-finished steel annually to the U.S. (compared with 600,000 that the U.S. had

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<sup>1/</sup> Steel pipe and tube imports from the EC had been banned in November 1984 because such imports substantially exceeded the level agreed to in the 1982 agreement that was noted above. In January 1985, a revised arrangement was negotiated for 1985 and 1986, and the ban on pipe and tube imports was lifted.

imposed initially in January). In return, the EC would eliminate the quotas on U.S.-produced fertilizer, animal fat and specially paper that it had imposed in January. 1/

#### IV. The Loss of Competitiveness of the U.S. Steel Industry

Numerous explanations have been advanced to account for the U.S. steel industry's loss of international supremacy. These include: excessive wage settlements in the United States, inadequate investment in new technologies, low levels of expenditure on research and development, burdensome environmental and other regulations, and unfair foreign competition. Many of these factors probably have been reflected in the cost structure of the U.S. industry as illustrated in Table 1 by the evolution of relative costs in the United States and Japan for cold-rolled sheet. 2/

In 1964, the operating cost of U.S. steel mills is estimated to have been \$117 per net ton of output, roughly 15 percent above that of Japanese producers. After allowance for the costs of entering the U.S. market from Japan, 3/ this differential was sufficient to leave U.S. steelmakers with a small competitive advantage. This favorable competitive position of U.S. producers reflected low raw materials costs and high labor productivity that largely offset the effect of wage rates that were approximately five times higher in the United States than in Japan.

By 1972, the competitive position of U.S. producers had deteriorated to the point where their unit operating costs were about 40 percent higher than those of Japanese producers. A major improvement in labor productivity in Japan had eliminated the earlier U.S. advantage in this area. By the same time, absolute declines in the cost of iron ore to Japanese producers had reversed the competitive edge previously enjoyed

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1/ In early 1987, U.S. specialty steel producers petitioned the Administration to extend quotas and tariffs for another four years beyond their scheduled expiration on July 19, 1987. Those producers claimed that an abundance of imported specialty steel, produced with the help of government subsidies, was continuing to depress prices and injure U.S. companies.

2/ Cold-rolled sheet, a typical product of integrated mills, has been the most important product (as measured by the value of shipments) of the U.S. steel industry in each year during the past three decades; it has accounted for roughly 20 percent of total net shipments by U.S. producers.

3/ It is estimated that these entry costs add about 18 percent to the total cost of Japanese producers indicated in Table 1.

by U.S. steelmakers in their use of this input; 1/ U.S. mills retained a price advantage for scrap and coal, owing to abundant domestic reserves. A surge in Japanese wages during the 1960s limited the extent to which the U.S. competitive position was eroded between 1964 and 1976; the average cost of labor in Japan rose almost 15 percent annually during this period compared with 6 1/4 percent in the United States.

Over the remainder of the 1970s, both U.S. and Japanese producers experienced major increases in wage costs in the face of a slowdown in the growth of labor productivity (see Table 1). During this period there was also a major rise in unit energy costs in both countries--a rise which increased the cost of steel relative to that of several substitutes, owing to the highly energy-intensive technology associated with steelmaking.

Wage rates in the U.S. steel industry, which, as noted earlier, have been considerably higher than those in the Japanese steel industry, are also high relative to other manufacturing industries in the United States (see following tabulation). In 1951, average hourly earnings for production workers in steel mills exceeded the average level for all manufacturing by almost 25 percent; by the early 1980's this differential had widened to 65 percent. In particular, in 1973 the major U.S. producers entered into a labor agreement that caused wages to escalate much more rapidly in steel than in other U.S. manufacturing industries; in return for a no strike commitment, the major producers agreed to automatic wage increases and cost-of-living adjustments. Consequently, average hourly earnings in steel rose from 35 percent above the manufacturing average in 1972 to 65 percent ten years later.

In response to a sharp decline in steel demand, hourly earnings in the steel industry decelerated in 1982 before dropping by 4 percent in 1983. This development in 1983 was related to wage concessions that were part of a special labor agreement negotiated in February 1983. 2/

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1/ During the 1960s, Japanese producers made a major effort to secure long-term supplies of iron ore at the lowest possible price, especially from Australia and Brazil. Also, transportation costs were reduced by the construction of major new plants at tidewater locations, thus maximizing the benefit of shipping by bulk, sea-going carrier. By contrast, the vertically integrated U.S. firms, which were often located inland or on the Great Lakes, continued to rely upon their own, relatively costly, North American sources of iron ore.

2/ Under this wage agreement, which was negotiated six months before the expiration of the previous contract, wages were cut (by \$1.31 per hour) in the first year of the contract, before being virtually restored by the end of the 41-month contract period. A cost of living adjustment clause was maintained in the contract, but it was modified so as to preclude payments until August 1984.

Despite this decline in 1983 and relatively small increases during the following two years, in 1985 wages in the steel industry were still almost 50 percent above the average for all manufacturing. 1/

Comparison of Average Hourly Earnings of U.S. Production Workers 2/

(In dollars per hour)

	<u>Blast Furnaces and Steel Mills</u>	<u>All Manu- facturing</u>	<u>Paper and Allied</u>	<u>Chemicals and Allied</u>	<u>Motor Vehicles</u>
1951	1.92	1.56	1.51	1.62	...
1961	3.19	2.32	2.34	2.58	2.96
1971	4.60	3.56	3.67	3.97	4.95
1981	13.13	7.99	8.60	9.12	12.29
1982	14.00	8.50	9.32	9.97	13.01
1983	13.42	8.83	9.92	10.58	13.34
1984	13.53	9.19	10.41	11.07	14.11
1985	13.98	9.53	10.82	11.56	14.82

A counterpart to high wage costs in the U.S. steel industry has been a chronically low rate of profitability (see tabulation below). Since the 1950s, the profitability of the steel industry measured in relation to shareholders' equity has generally been below the average for manufacturing--in most years by a fairly wide margin. In the period 1982-85, U.S. steel companies experienced net losses averaging almost 10 percent of shareholders' equity, compared with net profits of 11 and 9 percent for all manufacturing and for the durable goods sector, respectively.

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1/ Following a six-month strike, in early 1987 USX Corporation (the nation's largest steel producer) and the United Steel Workers concluded a four-year contract agreement which included further substantial wage concessions. Total labor cost concessions were estimated at \$2.45 per hour in the pact's first year, including an 8 percent cut in the average hourly base rate of pay. Savings are expected to decrease gradually over the course of the contract as some benefits are restored on a staggered basis.

2/ Source: U.S. Department of Labor, Bureau of Labor Statistics.

Net Income 1/

(As percent of stockholders' equity)

	<u>Steel 2/</u>	<u>All Manufacturing</u>	<u>Durable Goods</u>
1950-59	11.8	11.3	11.9
1960-64	7.1	10.0	9.6
1965-69	7.9	12.3	12.7
1970-74	8.1	11.5	10.8
1975-79	6.3	14.2	14.0
1980	8.6	13.9	11.2
1981	16.2	13.6	11.9
1982	-15.0	9.2	6.1
1983	-13.4	10.6	8.1
1984	-1.6	12.5	12.4
1985	-7.8	10.1	9.3

The slow growth of labor productivity in steelmaking in the United States relative to Japan has reflected to some extent the investment strategies of these industries. This is illustrated in Table 2 with data related to the introduction of relatively advanced technologies in the United States, Japan, and the EC. During the 1960s, investment in the basic oxygen furnace (BOF) 3/--a major technological advance of steelmaking in the 1960s--proceeded at roughly the same rate in the United States as in the EC, although both lagged the rate at which this technology was being introduced in Japan. The pace of implementation of this technology by U.S. firms flattened out in the mid-1970s at roughly 60 percent of the industry's total capacity. By way of comparison, after 1975 roughly 75 percent of steelmaking capacity in the EC and Japan used the BOF technology.

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1/ Sources: American Iron and Steel Institute, Annual Statistical Report, Annual Report of the Council of Economic Advisers, and "Quarterly Financial Report for Manufacturing, Mining and Trade Corporations", Department of Commerce, Bureau of the Census.

2/ Data prior to 1979 are not strictly comparable to later years owing to changes in coverage.

3/ This technology replaced the open hearth process which was the dominant approach to steelmaking in the United States through the earlier part of this century. The principal advantage of the basic oxygen furnace centers on its use of oxygen in the furnace which triggers a violent heat-producing chemical reaction. As a consequence, supplementary fuel sources become unnecessary and heat times (the time between charging the furnace and pouring molten steel) were drastically lowered in the late 1950s from about twelve hours with open hearths to about one hour with BOFs.

New capacity embodying the electric arc technology <sup>1/</sup> was also brought on stream at a relatively rapid pace in the United States during the 1960s. However, in contrast to the BOF process, the rate of implementation was maintained during the following decade (see Table 2). By the early 1980's, the output of U.S. steelmakers using the electric arc approach exceeded that of both their Japanese and European competitors. As measured by the combined share of output accounted for by these two advanced processes (the BOF plus the electric arc approach), the technology of U.S. steelmaking was at least comparable to that of the EC until 1975. Since then, however, the U.S. steel industry has been slow to shed its remaining inefficient mills and, in 1984, roughly 10 percent of U.S. output still used the older, open hearth technology. <sup>2/</sup> In contrast, the use of open hearth furnaces had been virtually eliminated in Japan by 1970 and in the EC by 1980.

A major technological innovation in the steel industry during the 1970s was the process of continuous casting. <sup>3/</sup> In contrast to its initially rapid transition to the BOF and electric arc technologies, the U.S. steel industry has been slow to adopt continuous casting (see Table 2). During the 13 years ending 1984, supply capacity based on the continuous casting technology rose by roughly 90 million net tons in Japan and by some 80 million tons in the EC; by contrast, only 30 million were introduced in the United States, of which roughly half was added during the period 1980-84. In 1984, only 40 percent of the U.S. steel-making capacity embodied continuous casting, compared with 89 percent for Japan and 65 percent for the EC.

A critical reason for the difference between the rates at which the United States and its competitors introduced more advanced technologies may be associated with the fact that since the 1950s the U.S. industry has tended to replace obsolete capacity while producers elsewhere were generally building new facilities. The significance of this difference is twofold. First, building replacement capacity as part of a complex, integrated facility requires compromises in design and scale because the new capacity must fit into an existing design configuration. Conse-

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<sup>1/</sup> The electric furnace is typically used to melt down scrap steel and, as described in more detail in the following section, it is generally associated with mini-mills. The main advantage of this technology over the open hearth process is a relatively rapid heat time.

<sup>2/</sup> Some advances have been made to the open hearth technology over the past two decades. These advances, coupled with the open hearth's ability to use more scrap iron than the BOP, have enabled some open hearth facilities to remain open although they continue to operate at a competitive disadvantage.

<sup>3/</sup> Traditionally, steelmaking has involved a complex series of discrete steps, some of which are eliminated in the process of continuous casting. In this process, intermediate products are eliminated and the molten steel is poured directly into a semi-finished stage. The main advantages of continuous casting are reduced wastage, lower energy requirements, and a product of more uniform quality.

quently, the resulting facility is not likely to be as efficiently organized as a totally new one. Second, the financial performance of a company that is replacing capacity ahead of schedule tends to be weaker than that of a firm that is building new capacity. In the former case, costs incurred to build the obsolete capacity (including financing costs) must still be met even though this capacity is generating no income.

#### V. The "Mini-Mills"

While the overall steel industry in the United States has lost its position of international supremacy since the late 1950s, a highly competitive class of new firms known as "mini-mills" has emerged. <sup>1/</sup> These firms, which typically are relatively small and employ nonunionized labor, may be differentiated from the traditional, integrated companies along three lines--technology, markets, and products. <sup>2/</sup> In general, the mini-mill technology uses electric furnaces to produce carbon steel from scrap iron, which is then continuously cast into forms suitable for final products. The markets served by mini-mills are usually located in small regional areas, well endowed with local sources of scrap, and sometimes insulated by high transportation costs from integrated producers and foreign competition. <sup>3/</sup> With regard to their product line, mini-mills have concentrated on relatively simple, low-value commodities (such as wire rod and concrete reinforcing bars), leaving the more complex products--in which economies of scale may be significant--to the large, integrated producers.

Estimates of the cost structure for a major mini-mill product (wire rod) in the United States, the Federal Republic of Germany and Japan are provided in the following tabulation. In 1981, the unit costs of wire rod produced by mini-mills in the three countries are estimated to have been approximately equal. As shown in the right half of the following tabulation, the costs of integrated producers in all three countries are considerably higher owing mainly to higher unit labor costs.

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<sup>1/</sup> The only U.S. firm ranked among the world's ten most efficient producers in 1984 was a mini-mill--ranked in third place. Of the other top ten firms, six were Japanese, one was Korean, and the other two were from members of the EC (*Iron Age*, May 3, 1985, p. 81).

<sup>2/</sup> In recent years, the success of the mini-mills has encouraged an expansion in their size and product line which has tended to blur the distinction between them and the older, integrated firms; technology is now their major distinguishing feature.

<sup>3/</sup> In 1975, the mini-mills accounted for roughly 15 percent of total capacity of the U.S. steel industry; this proportion is estimated to have increased to approximately 20 percent in the early 1980s.

Comparative Production Costs of Mini-Mills: Wire Rod, 1981 <sup>1/</sup>

(U.S. dollars per net ton shipped)

	Mini-Mills			Integrated		
	United States	Federal Republic of Germany	Japan	United States	Federal Republic of Germany	Japan
Labor	60	45	37	131	84	51
Ore	--	--	--	62	50	49
Scrap	93	96	96	15	5	3
Coal	--	--	--	52	75	59
Other energy	45	52	51	46	37	40
Other	65	69	68	66	61	64
<u>Total operating costs</u>	<u>263</u>	<u>262</u>	<u>252</u>	<u>372</u>	<u>312</u>	<u>266</u>
Depreciation	11	12	11	12	14	16
Interest	7	8	10	5	8	18
Taxes	3	1	2	5	2	4
<u>Total costs</u>	<u>284</u>	<u>283</u>	<u>275</u>	<u>393</u>	<u>336</u>	<u>304</u>

VI. Summary and Conclusions

After dominating the world steel market during the decade that followed the Second World War, the U.S. steel industry began to lose its position of international pre-eminence during the second half of the 1950s. By 1985, the importance of the U.S. steel industry had diminished to the point where it accounted for a small proportion of world output, and foreign producers had captured more than one-quarter of the U.S. domestic market. A review of trade policy in the area of steel indicates that this decline in the importance of the U.S. steel industry occurred in spite of some form of protection against imports almost continuously between 1969 and 1986.

This paper has reviewed the decline in the U.S. steel industry and has found it to be closely related to changes in the cost structure of the traditional integrated U.S. steel producers relative to their major international competitor over most of this period, Japan. In particular, during the period 1964-72, a major improvement in labor productivity in Japan eliminated an earlier U.S. advantage in this area, while absolute declines in the cost of iron ore to Japanese producers reversed a competitive edge previously enjoyed by U.S. steelmakers in their use of this input. At the same time that the traditional,

<sup>1/</sup> Source: Barnett and Schorsch (1983), Table 4-3.



integrated producers were losing their international competitiveness, the paper notes the emergence of a new class of U.S. steelmakers known as "mini-mills." A comparison of the cost structure of these steelmakers with their domestic and international competitors suggests that this segment of the U.S. steel industry is competitive internationally, and highly competitive relative to the traditional, integrated U.S. steel producers.

Table 1. United States and Japan: Estimated Unit Cost of Cold-Rolled Sheet

	Price of Input (In U.S. Dollars)		Use of Input <sup>1/</sup> (Per Ton of Output)		Unit Cost (U.S. Dollars Per Ton of Output)	
	United States	Japan	United States	Japan	United States	Japan
1964						
Total					117	102
Labor	4.4	0.9	10.0	19.1	44	17
Ore	12.0	12.9	1.4	1.7	17	22
Scrap	34.6	38.2	0.2	0.1	7	3
Coal	9.3	14.7	0.9	0.9	8	14
Other energy	...	...	...	...	15	16
Other	...	...	...	...	26	30
1972						
Total					155	113
Labor	7.1	2.8	8.1	8.2	57	23
Ore	14.6	10.9	1.6	1.9	23	20
Scrap	30.8	36.8	0.2	--	5	--
Coal	15.7	20.0	0.9	0.9	15	18
Other energy	...	...	...	...	20	17
Other	...	...	...	...	35	35
1980						
Total					374	286
Labor	18.8	11.0	7.2	5.9	135	64
Ore	36.0	25.5	1.6	1.8	58	46
Scrap	89.5	100.0	0.2	--	14	--
Coal	52.5	65.0	0.9	0.9	45	58
Other energy	...	...	...	...	46	42
Other	...	...	...	...	76	76

Source: Barnett and Schorsch (1983), Table 3-6.

<sup>1/</sup> Man-hours for labor; tons for ore, scrap, and coal.

Table 2. United States: Output Obtained From Advanced Technologies  
(Millions of net tons and percentage of total crude steel output)

	<u>United States</u>		<u>Japan</u>		<u>European Community</u>	
	Tons	Share	Tons	Share	Tons	Share
<u>Basic Oxygen Furnace</u>						
1960	3.3	3	2.9	12	1.8	2
1965	22.9	17	24.9	55	24.3	19
1970	63.3	48	81.2	79	65.1	43
1975	71.8	62	92.9	83	87.2	63
1980	67.6	60	92.7	76	102.9	73
1981	73.2	61	84.3	75	103.6	75
1982	45.3	61	80.6	73	89.5	74
1983	52.1	61	76.7	72	88.7	74
1984	52.9	57	84.2	72	97.7	74
<u>Electric Arc Furnace</u>						
1960	8.4	8	4.2	20	10.6	10
1965	13.8	11	9.2	20	15.2	12
1970	20.2	15	17.2	17	22.5	15
1975	22.7	19	18.4	16	26.5	19
1980	31.2	28	30.1	25	33.5	24
1981	34.1	28	27.8	25	32.7	24
1982	23.2	31	29.2	27	31.5	26
1983	26.6	32	30.4	28	31.1	26
1984	31.4	34	32.2	28	33.9	26
<u>Continuous Casting</u>						
1971	5.8	5	10.9	11	6.8	5
1975	10.6	9	35.1	31	22.9	17
1980	22.7	20	73.1	60	55.1	39
1981	24.5	20	79.2	71	62.4	45
1982	21.6	29	86.4	79	64.3	53
1983	27.2	32	92.5	86	72.4	60
1984	36.7	40	103.8	89	86.1	65

Sources: Barnett and Schorsch (1983), Table 3-2, International Iron and Steel Institute, Steel Statistical Yearbook; and International Iron and Steel Institute, World Steel in Figures, various issues.

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