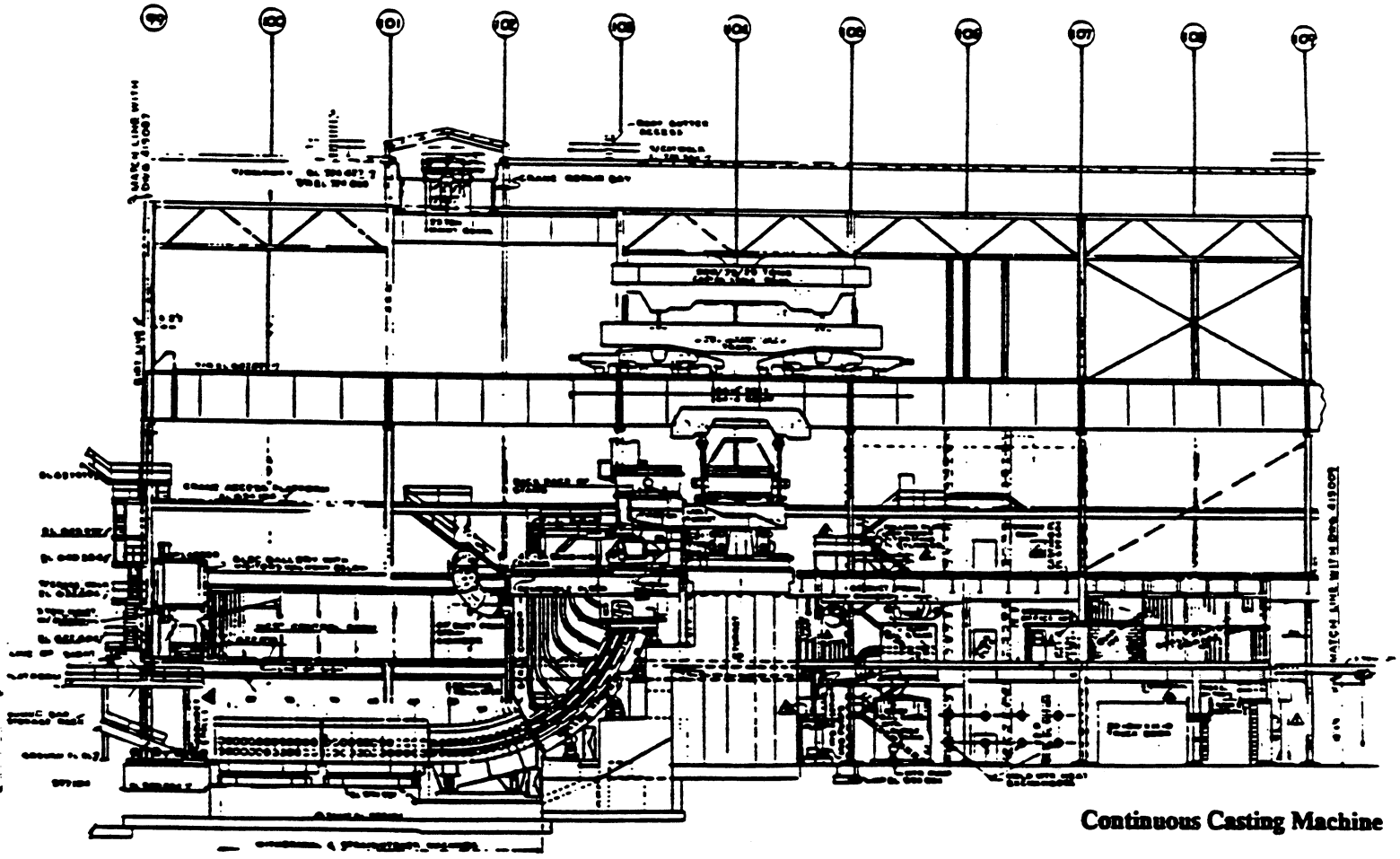
Steel Industry Annual Report

On Competitive Conditions In The Steel Industry And Industry Efforts To Adjust And Modernize

Report to the President on
Investigation No. 332-289
Under Section 332 of the
Tariff Act of 1930



Continuous Casting Machine

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UNITED STATES INTERNATIONAL TRADE COMMISSION

UNITED STATES INTERNATIONAL TRADE COMMISSION

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NOTE

The whole of the Commission's report to the President may not be made public since it contains certain information that has been classified by the United States Trade Representative or would result in the disclosure of the operations of individual concerns. This published report is the same as the report to the President, except that the above-mentioned information has been omitted (as indicated by asterisks) or combined with data from related product categories to ensure confidentiality.

PREFACE

On March 16, 1990, the United States International Trade Commission instituted investigation No. 332-289, Steel Industry: Annual Report on Competitive Conditions in the Industry and Industry Efforts to Adjust and Modernize. The investigation, conducted under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332 (g)), is in response to a request from the United States Trade Representative, pursuant to authority delegated by the President (appendix A).

Notice of the investigation was given by posting copies of the notice of investigation at the Office of the Secretary, U.S. International Trade Commission, and by publication of the notice in the *Federal Register* of March 22, 1990. See appendix B.

This report is the first of a series of two that will provide information on competitive conditions in the steel industry. Included is analysis of industry pricing trends, financial health and conditions in the domestic market, and an assessment of quality and service improvements in the industry for major carbon and specialty steel product categories. In addition, there is information on industry efforts to adjust and modernize, including information on wage commitments and investment expenditures. Analysis of these topics focuses on the period from January 1, 1989, through December 31, 1989, with 1990 year-to-date information incorporated, as available.

The report provides certain cash flow information for nine major U.S. companies for the 12-month period ending September 30, 1990, as needed for the President's annual determination concerning the commitment of the steel industry's cash flow required under section 806 of the Trade and Tariff Act of 1984 (Public Law 98-573). This information examines (1) the extent to which these companies have committed such funds to reinvestment in, and modernization of, the industry; (2) net expenditures for worker retraining; and (3) actions taken by major companies to maintain international competitiveness.

The Commission collected data and information from interviews with industry executives, independent analysts and investment bankers. The report also includes data developed from secondary sources and questionnaires sent to 208 producers and 240 purchasers of steel mill products covered by the voluntary restraint agreements (VRAs). Responses were received from 183 producers; the respondents comprise virtually all raw steel producers (over 98 percent), and a substantial percentage of steel converters (i.e., companies which process partially advanced steel such as slabs and rods into sheets and wire) (see appendix D, table D-1). Purchasers that responded to the questionnaires accounted for 32.9 million tons of steel purchases, including 8.6 million tons from steel converters and 24.4 million tons from distributors and end users. The distributors and end users accounted for 3.5 million tons and 20.8 million tons of purchases, respectively (see appendix D, table D-2).

The information and analysis in this report are for the purpose of this report only. Nothing in this report should be construed to indicate how the Commission would find in an investigation conducted under other statutory authority covering the same or similar matter.

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EXECUTIVE SUMMARY

MARKET CONDITIONS

Steel demand in the United States declined in 1989 from the 1988 level, but was still strong relative to demand during most of the 1980s.

- U.S. apparent steel consumption decreased by 6 percent, to 97.7 million short tons, from 1988 to 1989.
- The relatively strong market conditions in major foreign markets and the resulting higher prices in those markets contributed to a decline in U.S. steel imports, to a 6-year low of 18.2 million tons, with most VRA countries shipping significantly less to the U.S. market than their VRA tonnage limits.
- A doubling in the level of exports since 1988, to the highest level in a decade, helped to narrow the country's 1989 trade deficit in steel products to 12.7 million tons ($6.1 billion).
- Overall, nominal U.S. steel prices increased by 3.4 percent in 1989, compared to 5.0 percent for manufacturing industries as a group. Since 1986, however, the rate of increase has been higher for the steel industry (14.7 percent) than in all manufacturing (11.4 percent).

INDUSTRY CONDITIONS

On an annual basis, 1989 was a good year for the U.S. industry in terms of production, shipments, and profitability, relative to much of the 1980s. However, several long-term problems, such as low bond ratings, increasing labor costs, and potentially high costs for environmental control could affect its international competitive position.

- The U.S. steel industry produced almost 98 million tons of raw steel, operating at a raw steel capacity utilization level of 85 percent; net shipments totaled 84.1 million tons.
- U.S. steel industry gross sales (including intra-industry sales) of $51.4 billion generated $3.6 billion dollars in net operating profit (7.1 percent) in 1989, as compared to 6.5 percent for all manufacturing.
- After past contracts, which froze or lowered labor costs, several major producers signed labor contracts which will result in a $1.50-per-hour wage increase over the next 4 years. Additional provisions in the contracts could lead to an increase in hourly labor costs from their current level of $23.49 (about 1.6 times the level of compensation of manufacturing workers as a whole) to about $30, according to some analysts.
- A number of independent financial analysts with whom staff held meetings were pessimistic about the industry's long-term financial health, with some predicting further capacity closures during the next market downturn. The concern is reflected in the industry's bond ratings, which are rated as below investment grade by Moody's Investors' Service.

MODERNIZATION

Industry efforts to adjust and modernize involved actions aimed at lowering input and operating costs, improving facilities, altering corporate structures, and developing new products and services.

- Capital investment in the industry in 1989, totaling $3 billion, was directed to all areas of production. The process technologies accounting for most of the investment were flat-rolling mills (40 percent) and iron and steelmaking processes (30 percent). The investment is resulting in a net capacity increase in certain steelmaking processes and certain product areas, while at the same time inefficient facilities are being phased out.

- Minimill operators are continuing to move into higher value markets and may eventually pose a serious challenge to integrated firms in sheet markets. Steel converters, which purchase partially advanced steel (e.g. slabs, wire rod and hot rolled bands) for further processing, are continuing to expand their presence. The changes in these sectors are advancing the trend towards less concentration in both steel production and distribution.

- The major integrated producers in the industry are generally restructuring by focusing investment on facilities producing higher value flat-rolled sheet products. The restructuring has included a substantial number of joint ventures involving research, production, and marketing functions. The joint ventures have included both domestic and foreign partners. Most foreign investment in 1989 came from Japanese firms, although interest from European companies is increasing.

- The industry has improved the quality of its products and level of its service to customers. The progress has included increasing the interchange of electronic data with customers and suppliers, closer technical relationships with major consumers, improved production machinery, and new efforts in process monitoring and control.

- U.S. producer and purchaser respondents to the Commission's questionnaires both noted improvements in U.S. producers' product quality and customer service, consistent with investments made by the industry in equipment that enhances quality, such as continuous casters and vacuum degassers. Purchasers also noted that Japan more consistently offers a higher quality product than does the United States, although for certain products (such as stainless flat-rolled), the U.S. industry's quality is regarded as comparable to that of Japan and other global producers.

INTERNATIONAL CONDITIONS

The pace of globalization of the industry increased, as evidenced by more joint ventures and investment across national boundaries. The intent of these actions appears to be driven by producers' interests in locating facilities close to principal end users (in order to cultivate closer working relations with consumers as they develop and refine products).

- While the United States has been the focus of foreign investment in recent years, indications are that investment is expanding to other countries, many of which are in the Far East.

- On the trade front, the lowering of tariff and nontariff barriers, privatization of state-owned firms, and liberalization of steel markets are likely to create new opportunities for trade, resulting in an increase in the share of steel production traded internationally.

- In terms of U.S. international cost competitiveness, domestic mills' pretax operating costs have improved relative to other global competitors during 1990, narrowing the cost disparity between U.S. and major foreign producers. Steelmaking costs in other industrialized countries are estimated (in 1990) to be less than 10 percent lower than those in the United States (to produce cold rolled sheet, a key product), as compared to over 20 percent lower in 1984. Developing countries, however, still maintain a considerable cost advantage.

CASH FLOW COMMITMENTS OF MAJOR COMPANIES

Following is information relating to cash flow and cash flow commitments (including commitments for the retraining of workers) of the major steel companies for the 12-month period ending September 30, 1990.[1]

- During the period October 1, 1989-May 31, 1990, major companies' cash flow totaled $1.1 billion, while net steel-related expenditures equaled $1.5 billion. Projections provided by companies for the remaining June 1-September 30, 1990, period indicate that expenditures will continue to exceed cash flow.
- All companies with positive cash flow reported retraining expenditures in excess of 1 percent of net cash flow during October 1, 1989-May 31, 1990, a relationship expected to be maintained through September 31, 1990.
- Virtually all (99 percent) of the expenditures for retraining workers by the major companies were directed to current workers rather than displaced workers.

[1] Under section 806 of the Trade and Tariff Act of 1984 (P.L. 98 573), as amended, the President is required to make an annual determination to the Committee on Ways and Means of the House of Representatives and the Committee on Finance of the Senate as to whether the major companies of the steel industry have, taken as a whole, "committed substantially all of their net cash flow from steel product operations for purposes of reinvestment in, and the modernization of, the industry through investment in modern plant and equipment, research and development, and other appropriate projects, such as working capital for steel operations and programs for the retraining of workers." A determination must also be made as to whether each of the major companies committed not less than 1 percent of net cash flow to the retraining of workers.

Conditions in the Steel Industry

Highlights

In order to provide historical perspective on the status of the U.S. steel industry during the period that the Voluntary Restraint Agreements have been in effect, key data on production, employment, consumption, trade and financial conditions, covering the period 1984 through April 1990, have been included in table 1.

Table 1

Steel: U.S. raw steel production, capability utilization, employment, wages, shipments, imports, exports, apparent consumption, net sales, 1985-89 and specified periods, 1989 and 1990

							January-April	
	1984	*1985*	*1986*	*1987*	*1988*	*1989*	*1989*	*1990*
Raw steel:								
Production (1,000 short tons)	92,528	88,259	81,606	89,151	99,924	97,943	34,499	32,619
Capability utilization (percent)	68.4	66.1	63.8	79.5	89.2	84.5	90.3	84.9
Continuously cast (percent)	39.6	44.4	55.2	59.8	61.3	64.8	62.2	66.5
Employment:								
Total (thousands)[1]	334.1	302.6	273.5	268.4	277.2	274.3	[2]276.2	[2]268.3
Production workers (thousands)[1]	256.8	231.5	208.8	202.9	214.6	211.6	[2]214.1	[2]206.2
Hourly employment cost[3] (dollars)	20.26	21.43	21.95	22.63	23.58	23.49	([4])	([4])
Average hourly earnings (dollars)	12.98	13.33	13.73	13.77	13.97	14.23	14.09	14.74
Steel:								
Shipments (1,000 short tons)	73,739	73,043	70,263	76,654	83,840	84,100	29,273	28,001
Imports (1,000 short tons)	26,163	24,256	20,692	20,414	20,891	17,320	5,974	5,256
Exports (1,000 short tons)	980	932	929	1,129	2,069	4,578	1,494	1,471
Apparent consumption (1,000 short tons)	98,922	96,367	90,026	95,940	102,662	96,842	33,753	31,786
Ratio of imports to consumption (percent)	26.4	25.2	23.0	21.3	20.3	17.9	17.7	16.5
Steel operations:								
Net steel sales (million dollars)	30,005	26,272	24,675	26,933	32,466	31,969	[2]8,249	[2]8,143
Net steel income[5] (million dollars)	(31)	(1,834)	(4,150)	1,077	(567)	1,478	[2]663	[2]314
Ratio of income to net sales (percent)	(0.1)	(6.5)	(16.7)	4.0	(1.7)	4.6	[2]8.0	[2]3.9

[1] These figures represent employment in Standard Industrial Code (SIC) 331, which includes the electrometallurgical products (or ferroalloy) industry. In the past, this industry, which is generally not defined as part of the steel industry, has represented less than three percent of total employment levels reporting under this SIC.

[2] First quarter only.

[3] Total employment costs (including benefits) of employees receiving wages.

[4] Not available.

[5] Year-to-date data are for operating (not net) income.

Source: Compiled from data of the American Iron & Steel Institute and official statistics of the U.S. Department of Commerce and the U.S. Department of Labor (Bureau of Labor Statistics).

Production, Capacity, And Capacity Utilization

Raw Steelmaking

Following several years of capacity reductions, mestic producers' steelmaking capacity in-eased by 3.5 percent to nearly 116 million tons ring 1989 (table 2). While renovations at cer-n integrated mills have contributed to capacity ditions, current and future additions are most ely to occur in the minimill sector, where ca-city is expanding both through renovation and eenfield (new facility) construction, such as a eet mill recently constructed by Nucor. The tent to which the current expansion continues ultimately dependent on the future strength of e economy, particularly the construction, ma-inery, and automotive industries, which jointly count for nearly 80 percent of domestic steel nsumption (see Steel Consumption).

In contrast to rising capacity, production de-eased by about 2 percent during 1989, to 97.9 illion tons, reflecting weakening demand during e second half of the year (table 2); as a result, pacity utilization fell by about 5 percentage ints during 1989. Declining production ap-ared to continue through the first 4 months of '90 as raw steel production during January-pril was approximately 1.9 million tons (5.5 rcent) below the production level established ring January-April 1990. Capacity utilization is correspondingly lower during January-April '90 than in January-April 1989.

Continuously cast production is steadily in-easing as a share of total U.S. steel production, ereby elevating the competitiveness of the U.S. el industry. Continuous casting generates less rap and provides significant time, labor, and ergy savings relative to older casting methods. Nearly 65 percent of the steel produced in the United States during 1989 was continuously cast, and data for the first 4 months of 1990 indicate that the continuous casting ratio has increased to 66.5 percent (table 2). Leading Western producers, such as Japan and West Germany, have continuous casting ratios of 93 and 88 percent, respectively.[1]

Product Markets

Among carbon steel products, capacity utilization was highest among sheet and strip products (78 percent) during 1989 (table 3), principally as a result of high capacity utilization at hot strip (79 percent) and galvanizing facilities (92 percent) serving consumers such at the automotive industry (appendix table D-3). Capacity utilization (among disaggregated steel mill products) was lowest in pipes and tubes and rails and rail products; items for which markets generally have been unattractive throughout the 1980s.

Exhibiting the sharpest growth in capacity utilization during January-March 1990 were facilities producing medium and large structurals for the construction industry; the increase appears to reflect especially strong demand on the West Coast during a period when traditional foreign suppliers in Japan and Korea made few shipments (due to strong internal demand). High capacity utilization may also have resulted from the intensified efforts of minimills such as Nucor-Yamato and Chaparral to keep production costs down. Price competition between domestic mills in the market for wide flange beams continued to be intense during the first quarter of 1990. Capacity utilization essentially remained unchanged in other major product categories.

[1] The Japan Iron and Steel Federation, *The Steel Industry of Japan 1989*, p. 19.

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eel: U.S. producers' raw steelmaking capacity, production, capacity utilization, and share of continu-sly cast steel, 1980-1989, Jan.-Apr. 1990

riod	Capacity	Production	Capacity utilization	Share of continuously cast steel
	Million short tons		Percent	
80	153.6	111.8	72.8	20.3
81	154.3	120.8	78.3	21.6
82	154.1	74.6	48.4	29.0
83	150.5	84.6	56.2	32.1
84	135.2	92.5	68.4	39.6
85	133.6	88.3	66.1	44.4
86	127.9	81.6	63.8	55.2
87	112.2	89.2	79.5	59.8
88	112.0	99.9	89.2	61.3
89	115.9	97.9	84.5	64.8
n.-Apr.				
989	38.2	34.5	90.3	62.2
990	38.4	32.6	84.9	66.5

urce: American Iron and Steel Institute, *Annual Statistical Report*, various issues.

Table 3

Steel: Weighted average capacity utilization among major product groups, 1989 and Jan.-Mar. 1990

Item	1989	1990 (Jan.-M
Certain carbon and alloy steel:		
Sheet and strip	78	76
Plate	65	65
Bars and light structurals	77	75
Medium and heavy structurals[1]	70	80
Pipes and tubes	54	57
Rails and related products	48	52
Wire rod, wire, and wire products	71	71
Stainless and alloy tool steel:		
Sheets and strip	77	72
Plate	80	88
Bars and light structurals	67	67
Pipes and tubes	59	51
Wire rod, wire, and wire products	59	57

[1] Structural shapes with a cross section exceeding 3 inches.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commissi

Although integrated steel producers remained the primary producers of flat products—sheets, strip, and plate—during 1989, they were not the principal suppliers of other steel mill products, reflecting the movement of minimills and converters into markets once predominantly supplied by the integrated mills (table 4). The production of bars, structurals, and wire rods were dominated by minimills during the year, with minimills supplying over 60 percent of all medium and heavy structurals to steel consumers. In addition, converters,[2] finding their niche in less capit tensive product markets, were the le suppliers of fabricated steel mill products su pipe and tube, wire, and wire products d 1989.

[2] Steel converters purchase semifinished or finish steel mill products (such as wire rod or steel slabs) convert them to other steel mill products (such as w and steel sheets).

Table 4

Carbon and certain alloy steel: Production by U.S. integrated mills, minimills, and converters, by product, 1989

(1,000 short tons)

Product	Integrated mills	Minimills	Conve
Cokemaking	24,917	(1)	(1)
Ironmaking	53,671	(1)	(1)
Steelmaking			
Basic oxygen process	58,467	(1)	(1)
Electric furnace	6,421	26,499	(1)
Open hearth process	4,442	(1)	(1)
Products:			
Sheets and strip			
Hot-rolled	48,617	91	1,669
Cold-rolled	27,630	[***]	[***]
Galvanized	9,754	0	1,310
Other coating	4,822	0	404
Plates	3,852	1,179	0
Bars and light structurals			
Hot-finished	2,740	12,479	425
Cold-finished	[***]	[***]	727
Medium and heavy structurals[2]	1,718	3,072	164
Pipes and tubes			
Seamless pipes	[***]	[***]	101
Welded pipes	776	680	2,0[illegible]0
Other pipe and tube	[***]	[***]	27
Rails and rail products	[***]	[***]	0
Wire rods and derivatives			
Wire rods	[***]	3,742	[***]
Wire	[***]	[***]	1,132
Wire products	[***]	[***]	668

[1] Not applicable.

[2] Structural shapes with a cross section exceeding 3 inches.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commiss

Labor Conditions

Reflecting the effects of reduced production on operations, steel industry employment and productivity declined slightly in 1989. Nominal compensation costs, however, remained virtually unchanged at $23.49 per hour. During 1989, a number of labor contracts were concluded, a discussion of which is included later in this section.

Employment Levels

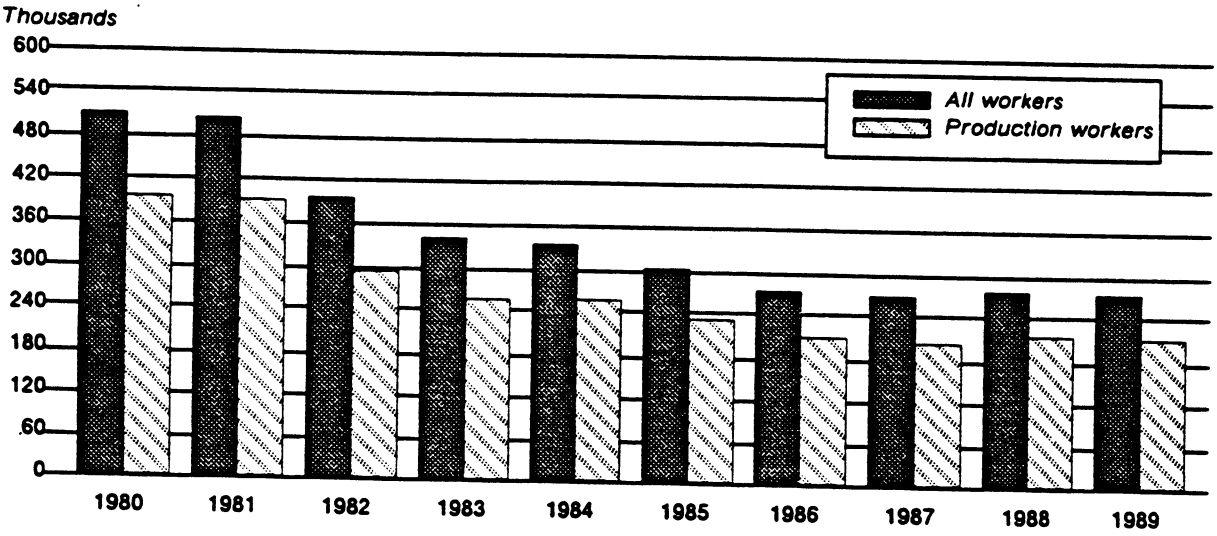
As depicted in figure 1, the total number of workers in the industry declined steadily from 1980 to 1986, during which time the work force was reduced by about half. Since then, however, labor cutbacks have slowed. In fact, as the market rebounded in 1988, the labor force rose by 3 percent, the largest percentage increase since 1973. As the market began to slow again in 1989, the labor force resumed its contraction (by one percent). Data through the first quarter of 1990 show a continuation of this trend, with a reduction in the labor force of 3 percent compared to the first quarter of 1989.

Compensation

During 1989, nominal hourly compensation[3] for production workers in the steel industry essentially remained at its 1988 level and real compensation decreased by 5 percent, which was the largest percentage decrease since 1984 (table 5). Despite the decline, production workers in

[3] Compensation includes both direct and indirect payments to workers. Direct payments include payment for time worked (e.g., wages), payment for time not worked (e.g., vacation and holiday pay), bonuses, and other incentive or special pay. Indirect payments include employer contributions to legally required insurance programs and contractual and private benefit plans.

Figure 1
Employment in the U.S. steel industry, 1980–89



Source: Official statistics of the U.S. Department of Labor, Bureau of Labor Statistics.

Table 5
Real and nominal compensation cost for production workers, steel industry and all manufacturing, and the ratio of compensation in the steel industry to compensation in the manufacturing sector, 1980–1989

Year	Steel		All manufacturing		Steel/ Manufacturing
	Nominal	Real[1]	Nominal	Real[1]	
	(dollars per hour)				
1980	17.46	26.27	9.84	14.81	1.77
1981	19.04	25.97	10.84	14.79	1.76
1982	22.72	29.19	11.64	14.96	1.95
1983	21.14	26.32	12.10	15.06	1.75
1984	20.26	24.18	12.51	14.93	1.62
1985	21.43	24.70	12.96	14.94	1.65
1986	21.95	24.83	13.21	14.95	1.66
1987	22.63	24.70	13.40	14.63	1.69
1988	23.58	24.72	13.85	14.52	1.70
1989	23.49	23.49	14.31	14.31	1.64

[1] Calculated by the staff of the U.S. International Trade Commission using 1989 as a base year and the consumer price index (urban) as a deflator factor.

Source: Compiled from official statistics of the U.S. Department of Labor, Bureau of Labor Statistics, Office of Productivity and Technology; except as noted.

the steel industry, at $23.49 per hour, received about 1.6 times the level of compensation of manufacturing workers as a whole.

A comparison of production workers' 1989 average hourly earnings (which exclude nonwage earnings) shows that the $14.23 per hour paid to steel production workers was 1.4 times that of workers in manufacturing industries in general (table 6). This represents a narrowing of the gap between steel and manufacturing since the early 1980s, when the ratio averaged 1.6. As was the case with total compensation costs, the increases in average hourly earnings have not kept up with inflation in the 1980s, resulting in a decline in real terms; in 1989, real earnings dropped by 3 percent. The portion of total hourly compensation represented by average hourly earnings appears to have dropped by about 5 percentage points in the 1980s, to 61 percent in 1989. This reflects, among other things, the increase in nonwage earnings such as health-care benefits and profit-sharing plans (see Labor Agreements).

Productivity

As the industry downsized and invested ir new capital equipment, significant improvement were made in worker productivity, as measured ir output per employee hour (table 7). Steel indus try productivity rose 61 percent from 1980 t(1989 (compared to 38 percent for all manufactur ing). Productivity decreased slightly (less than 1 percent) in 1989, apparently reflecting the effec of declining production levels on operations. Nevertheless, the productivity level in 1989 wa still relatively high, representing a 9-percent in crease from 1987.

With the exception of a brief period in th early 1980s, the rate of productivity growth ha far exceeded that of real hourly compensatio (figure 2). This is due to several factors, includ ing continued labor force reductions, th

[4] As production declines, the labor required to operat facilities is likely to decline as well, but not to the same extent. In many instances, for example, the need to sta facilities at certain levels limits the extent to which employment levels can be altered (i.e., it may take a prescribed number of workers to operate a piece of equipment, no matter what the production level).

Table 6

Average hourly earnings[1] of production workers, steel industry and all manufacturing, and the ratio of hourly earnings in the steel industry to hourly earnings in the manufacturing sector, 1980–1989

Year	Steel	All manufacturing	Steel/ manufacturing
	— (dollars per hour) —		
1980	11.39	7.27	1.57
1981	12.60	7.99	1.58
1982	13.35	8.49	1.57
1983	12.89	8.83	1.46
1984	12.98	9.19	1.31
1985	13.33	9.54	1.40
1986	13.73	9.73	1.41
1987	13.77	9.91	1.39
1988	13.97	10.18	1.37
1989	14.23	10.47	1.36

[1] The calculation of average hourly earnings includes overtime earnings and therefore will exceed average hourly wage rates.

Source: Compiled from official statistics of the U.S. Department of Labor, Bureau of Labor Statistics, Office of Productivity and Technology.

Table 7

Index of U.S. labor productivity of all employees, steel industry and all manufacturing, 1980–1989

(Output per employee hour (1980=100.0))

Year	Steel	All manufacturin
1980	100.0	100.0
1981	108.8	102.3
1982	88.3	104.9
1983	113.5	110.3
1984	127.6	116.3
1985	135.6	121.5
1986	137.8	126.1
1987	148.0	130.8
1988	163.6	134.3
1989	161.1	138.0

Source: Compiled from official statistics of the U.S. Department of Labor, Bureau of Labor Statistics, Office of Productivity and Technology.

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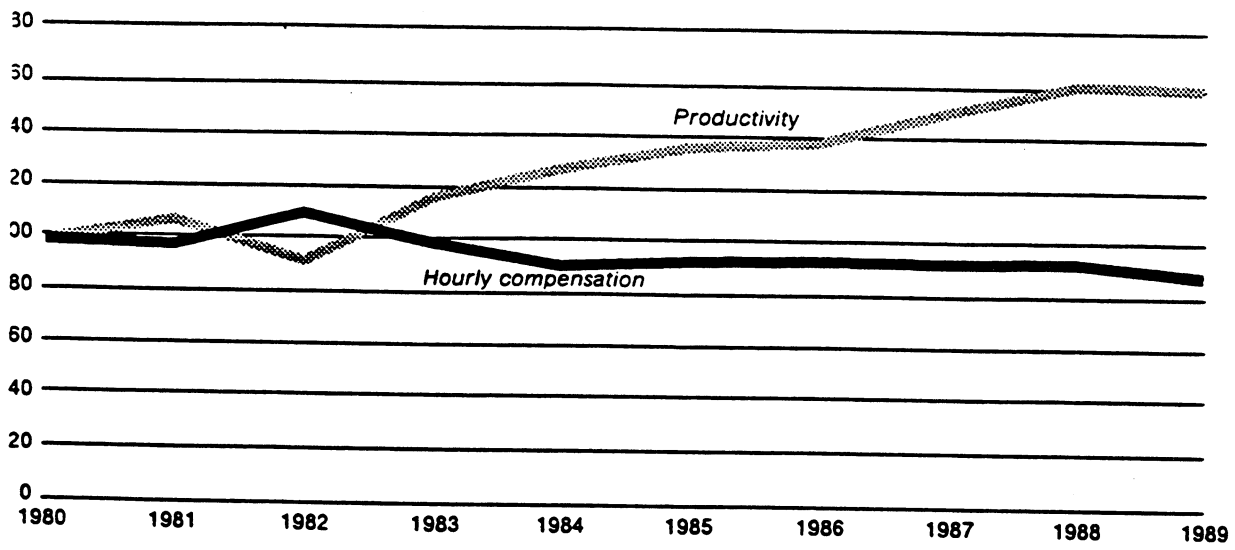
lexes of productivity and hourly compensation for U.S. steel production workers, 1980-89

ase year = 1980)



urce: Compiled from official statistics of the U.S. Department of Labor, Bureau of Labor Statistics.

ceptance of real wage cuts by labor, the invest-ent in more efficient equipment, and provements in management techniques. As a sult, the total cost of labor per unit of output s steadily decreased, indicating that steelmak-g is becoming a less labor-intensive process.

Labor Agreements

During 1989-90, unions representing steel-rkers negotiated a number of new contracts th steel companies which not only eliminated y and benefit concessions made during the 80s, but provided for pay increases over a mul-ear period as well. In addition, many of the w agreements included provisions under which rkers could receive training to enhance their reer development.

SWA Agreements

During January 1989-June 1990, the United eel Workers of America (USWA) concluded 30 or contracts with steel companies, covering er 93,000 workers, representing 63 percent of USWA members[5]. While there were company d regional variations in steel industry settle-nts during 1989, most of the contracts with the SWA conformed to a similar pattern. Following a summary of the principal elements common most of the agreements.[6]

Most agreements will be effective for 4 years although there are some that cover between 3 and 5 years. Wages and fringe benefits were restored in the first year of the 1989 agreements to their early- to mid-1980s level. In addition, wages will increase by an average of $1.50 per hour during the 4-year agreements. At the end of the 4-year agreements, the average hourly wage rate for nonincentive workers in the industry will be about $13.70.[7] Further pay adjustments could be made under provisions relating to inflation. Such provisions, effective in the third and fourth year of the contracts, stipulate that wages will be increased equal to the amount of inflation exceeding 3 percent. In addition to wages, provisions for profit sharing are included in almost all of the 1989 agreements; under these provisions, companies will share about 10 percent of pretax profits with workers.

Additional provisions of the 1989 agreements called for improvements in pension benefits and retirees' life insurance, as well as a reduction in major medical premiums paid by retirees. Henceforth, 50 percent of the premium for retirees' major medical plans will be paid by the steel companies. For active workers, improvements were made in health, accident, and life insurance and supplemental unemployment benefits; dental and major medical coverage were also increased from $25,000 to $50,000.

[5] Telephone interview with USWA Public Relations fice conducted by staff of the USITC on May 19, 90.

[6] Edward Ghearing, Research Department, USWA; er to the U.S. International Trade Commission, Apr. 1990.

[7] Average hourly wage rates do not include overtime earnings, and therefore will be less than average hourly earnings.

The current agreements with the major steel companies also established the National Policy for Steel Committee. The committee, comprised of the president of the USWA and the presidents of the respective steel companies, will reportedly develop a unified position on national issues of trade policy, health, infrastructure, environment, and fiscal and monetary policy.

Another provision in the 1989 agreements calls for the creation of a Career Development Program. This program, which is currently funded by five companies[8] at a rate of about 10 cents per hour per worker, is designed to provide opportunities for further training and personal development. The 1989 agreements also include a newly negotiated Overtime Control Program which requires companies to make penalty payments if overtime for any one worker exceeds 16 hours per week. The funds raised by this program will be used to finance the Career Development Program. The parties also agreed to seek and use funds from Federal, State, and local governmental agencies to support the program.

Non-USWA Agreements

In addition to the USWA contracts, a number of companies negotiated contracts with nonmember independent workforces during 1989–90. These firms included Weirton, Armco Steel Co., Armco Advanced Materials, Rouge, and LaSalle Steel Co. In general, these agreements, like those concluded by the USWA, included wage restorations or increases and the improvement of other benefits regarding vacations, holidays, insurance, and pensions.

Financial Experience Of U.S. Producers

Industry Profitability[9]

Favorable market conditions and improvements in the efficiency of steelmaking operations have resulted in significant profit improvement among integrated producers, minimills, and specialty producers during 1984–90, as shown in table 8. The four industry segments[10] have different cost structures, reflecting the employment of different manufacturing processes and the use of different raw materials (table 9). The cost structure of integrated mills tends to be more stable as their long-term ore contracts contribute to relatively stable factor prices; minimills and specialty producers are more subject to cost fluctuations given their heavy reliance on scrap, the price of which is more volatile than iron ore (see appendix H).

[8] National, LTV, Inland, Bethlehem, and Armco, Inc.

An evaluation of selling, general and admi trative (SG&A) expenses indicates signific improvement between 1984 and 1989, as number of nonproduction workers was redu by an average annual rate of 4 percent.[11] In dition, SG&A expenses as a percent of s declined as new business technology and sa freezes were implemented between 1984 1989.

The steel industry's net operating profits percentage of sales rose to 7.1 percent in 1 following losses during the mid-1980s (table While representing a decline from 1988 (du weaker market conditions), the margins com favorably with that for all manufacturing, wl averaged 6.5 percent in 1989.[12]

Results varied, however, among the majo dustry segments. Specialty steel produ registered the highest profit margins of the segments for calendar 1989 (table 9 and ap dix D, table D-4). With the weakening of market in 1990, margins declined for the cialty and integrated producers during January–March quarter (appendix H, tables and H-7).

Profitability by Product Line

For carbon and alloy steel products, the h est net operating profit margins[13] in 1989 attained in plate and structural shapes, refle the strength of construction markets (table The largest margins in speciality steel were ge ated by producers of plates, sheet, and s Reflecting lower demand for steel during the quarter of 1990, most product lines register drop in profit margin. All pipe and tube proc showed stronger profit margins during the quarter of 1990, largely in response to incre activity in energy markets. Profit margins stainless wire rod also increased during that s period.

[9] Historical financial data discussed in this sectio drawn from data collected in conjunction with invest tion 332-209, which used ily 1 to June 30, reportir periods (see appendix H). ost data in this investig (332-289) are being collecte on a calendar-year ba resulting in an overlap during 989.

[10] For the purpose of analysi , the steel industry h been separated into four segments: integrated mills, minimills, specialty mills, and converters. Converter firms which purchase partially advanced steel (such wire rod and steel slabs) and convert it into higher v added products (such as wire and steel sheet).

[11] U.S. Department of Labor, Bureau of Lab Statistics, Office of Productivity and Technology.

[12] U.S. Department of Commerce, "Quarterly cial Report for Manufacturing, Mining and Trade Corporations", Fourth Quarter 1989, p. 132.

[13] Excludes certain financial items such as interes

Table 8

Net operating profit (loss) as a percent of sales, 1984-1989, and Jan.-Mar. 1990

(Percent)

Period	Integrated	Minimills	Specialty	Converters	Total
1984/85[1]	(2.6)	2.7	(0.8)	([2])	(1.6)
1985/86[1]	(3.2)	3.4	1.5	([2])	(1.7)
1986/87[1]	0.9	6.8	3.4	([2])	2.2
1987/1988[1]	8.0	8.9	10.2	([2])	8.3
1988/89[1]	8.1	10.3	13.3	([2])	9.0
1989	6.5	7.5	12.1	5.1	7.1
1990 (January-March)	3.5	7.8	10.8	5.3	5.4

[1] Twelve month period ending June 30.
[2] Not available.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table 9

Steel: Key financial ratios of U.S. producers by segment for the year ending Dec. 31, 1989

(Percent of total net sales)

Item	Integrated[1]	Minimills[1]	Specialty[1]	Processors[1]	Total
Net sales:					
Excluding intracompany and intercompany transfers	93.9	93.5	96.1	94.7	94.1
Intracompany and intercompany transfers	6.1	6.5	3.9	5.3	5.9
Total net sales	100.0	100.0	100.0	100.0	100.0
Cost of goods sold (including intra-company and intercompany transfers):					
Raw materials[2]	32.2	40.1	41.0	63.5	39.9
Direct labor[2]	21.4	12.1	14.3	6.7	16.3
Other factory costs, including depreciation and amortization[2]	36.0	35.1	27.5	17.4	32.0
Total cost of goods sold[3]	89.6	87.3	82.8	87.6	88.2
Gross profit or (loss)	10.4	12.7	17.2	12.4	11.8
General, selling, and administrative expenses	3.9	5.1	5.1	7.3	4.7
Net operating profit or (loss)	6.5	7.5	12.1	5.1	7.1
Other income or (expense):					
Net interest income or (expense)	(0.5)	(2.2)	(0.8)	(1.8)	(1.0)
All other income or (expense)	(0.2)	(0.3)	(0.7)	0.3	(0.2)
Total other income or (expense)[4]	(0.7)	(2.5)	(1.5)	(1.5)	(1.3)
Net profit or (loss) before taxes	5.8	5.0	10.7	3.6	4.6
Depreciation and amortization	3.9	4.2	1.7	2.1	3.5

[1] Certain respondents included financial information on related products.
[2] Estimated by the staff of the U.S. International Trade Commission based on partial company responses.
[3] Including nonitemized costs.
[4] Including nonitemized expenses.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table 10

Steel: Total net sales and net profits and losses as a percentage of sales, by selected product, 1989, and Jan. 1, 1990-Mar. 31, 1990

Item	Total net sales[1]		Net operating profit or (loss) as a percent of sales[2]	
	1989	Jan.-Mar 1990	1989	Jan.-Mar.[3] 1990
	— Thousand dollars —			
Carbon and certain alloy steel:[4]				
Semifinished	1,548,395	329,692	1.7	2.0
Plates	2,833,393	809,302	12.5	9.1
Sheets and strip:				
Hot-rolled	7,535,056	1,645,686	6.6	1.9
Cold-rolled	6,480,568	1,697,992	6.6	3.7
Galvanized	6,336,753	1,492,915	8.0	6.5
Other	4,346,699	962,471	7.3	4.1
Subtotal, sheets	24,696,076	5,799,064	7.1	3.9
Bars:				
Hot-finished	4,935,282	1,299,258	6.4	5.9
Cold-finished	899,749	221,787	3.2	2.7
Subtotal, bars	5,835,031	1,521,045	5.9	5.4
Wire	858,897	195,373	3.7	3.4
Wire rod	1,429,741	306,722	4.9	3.4
Wire products	899,146	228,211	3.6	3.2
Structural shapes and units	2,369,165	592,400	12.1	8.8
Rails and related products	350,926	97,874	(0.4)	1.4
Pipes and tubes:				
Line	713,753	206,999	3.3	5.1
Mechanical	1,832,267	326,693	4.7	7.4
OCTG	644,171	218,966	(5)	1.3
Structural	378,073	90,165	8.5	9.4
Other	971,014	244,561	9.7	8.7
Subtotal, pipes	4,539,278	1,087,384	4.6	6.2
Subtotal, carbon steel	45,350,048	10,967,067	6.2	4.4
Stainless and tool steel:				
Semifinished	338,646	65,896	7.3	8.0
Plates	669,988	157,259	15.5	12.5
Sheets and strip	2,563,015	551,780	13.6	11.7
Bars and shapes	1,100,746	234,719	6.2	9.3
Wire	180,047	40,619	10.5	15.2
Pipes and tubes	116,500	29,393	4.9	12.8
Wire rod	142,539	26,595	2.5	3.1
Subtotal, stainless and tool steel	5,111,481	1,106,261	11.2	11.0
Grand total	50,461,529	12,073,328	6.7	5.0

[1] Includes intracompany and intercompany transfers, less discounts, returns, and allowances.
[2] Operating profit is defined as the total net sales, less the cost of goods sold, general, selling and administrative expenses.
[3] Data reflects unlike period comparisons and is unadjusted for seasonal factors.
[4] Certain alloy refers to alloy steel other than stainless and alloy tool steel.
[5] Not applicable due to losses registered during the period.
[6] Not available.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Financial Position

Financial data compiled by the American Iron and Steel Institute indicate that steel company balance sheets, related only to their steel operations, changed relatively little in 1989. In measuring liquidity, the current ratio[14] for steel companies in aggregate declined slightly from 1.8 in 1988 to 1.7 in 1989, a relatively insignificant change in the industry's ability to obtain short-term credit. This compares favorably to a ratio of 1.3 for all manufacturing corporations with assets over $1.0 billion.[15]

The debt-to-equity ratio at the end of 1989 improved, decreasing from 2.3 to 2.0 as long term debt fell by 3.7 percent and equity increased

[14] Computed by dividing the total of current assets by the total of current liabilities.

[15] U.S. Department of Commerce, "Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations," Fourth quarter 1989, p. 134.

y 11.6 percent. In comparison, the ratio for all orporations in manufacturing (with assets over 1.0 billion) was 0.58, or one-third that of the eel industry.[16] Steel companies earned 8.1 per-ent on total assets[17] in 1989, compared to 5.2 ercent for all manufacturing companies.[18]

Bankruptcies

During 1989, Lone Star Steel Co., a producer f hot-rolled coils and pipe, and Davis Walker orp, a major producer of wire and wire prod-cts, filed for protection from creditors under hapter 11 of Federal bankruptcy laws. These ompanies joined LTV Steel Corp., Sharon Steel orp., and Wheeling-Pittsburgh Steel Corp. as ompanies in the industry currently operating un-er such protection.

Improving market conditions have diminished ıe frequency of bankruptcy filings in the steel ıdustry since the mid-1980s. Contributing to this end is the fact that most steel companies have educed the debt on their balance sheets since 980; debt levels have fallen from $6.8 billion in 980 to $4.9 billion in 1989.

Views of Financial Analysts[19]

The opinions of financial analysts can signifi-antly affect the ease with which companies can btain financing for projects, and the terms on hich such financing is granted. Analysts con-ılted by staff were generally in agreement about oth the short- and long-term outlooks for the teel industry, indicating that while improvement .ad been made over the last several years, some egments of the industry could still experience roblems under certain conditions. Problems oreseen in the near-term were rising imports, sof-ening demand, a stronger dollar, and higher ıbor costs. Longer-term, the analysts noted con-erns regarding the sufficiency of modernization fforts, the rising costs of compliance with pollu-on standards, the rising cost of health care, and ıe problems the industry continues to encounter hen raising capital.

The parties consulted indicated that the po-ential costs to be incurred by steel companies in rder to comply with the Clean Air Act are diffi-ult to estimate, but could be on the order of $5 illion. Approximately $3 billion of this is esti-ıated to be required for bringing coke ovens into ompliance. Concerns were voiced that the finan-ial implications of such expenditures could be severe, particularly if coupled with the possibility that certain coke ovens could be shut down per-manently.

Other major concerns mentioned by invest-ment bankers were the high labor and pension costs funded by integrated producers. Each inte-grated steelworker is apparently supporting an average of two retirees, and this average could in-crease as the number of workers employed in integrated mills declines. The longer term costs are especially significant because the retirees from integrated mills tend to be relatively young.

The Market

The general consensus among these financial analysts and investment bankers is that steel de-mand in 1990 will be lower than in 1989, totaling about 90 million tons. As a result, profitability and steel prices are expected to decline. Demand from the automotive industry, which is a principal steel consumer, is expected to remain steady this year,[20] as auto production is estimated to be on the order of 14 to 16 million units. Factors iden-tified as likely to temper demand include declines in commercial construction activity and appliance sales (as a result of fewer new housing starts), and the continuing long-term trend of the substitution of aluminum and plastic materials for steel prod-ucts.

Although U.S. imports are running slightly be-low the level of last year, and are significantly below quotas established by the Voluntary Re-straint Agreements, analysts believe that demand is weakening in foreign markets and that in-creased exports to the U.S. market can be expected. Most analysts indicate that more fa-vorable exchange rates, especially in relation to the yen, and greater commitment to export mar-kets will be required to maintain the competitiveness of the domestic steel industry in foreign markets. The consensus among analysts is that producers could do little to protect them-selves from an appreciation in the value of the dollar.

Analysts indicate that factors adversely affect-ing the steel industry at present include a decline in capital spending, inflationary pressures on raw materials costs, and competitive pricing pressures stemming in part from declining prices in Europe. Capacity utilization during the first quarter of 1990 was 5 percent less than that of the first quarter last year, and a number of analysts are forecasting up to a 7-percent decline for the year from the 1989 level. Global consumption during 1990 is expected to be down by 3 percent, lead-ing to increased pressure on U.S. producers as foreign competitors intensify efforts to sell their supplies outside their domestic markets.

[16] Ibid.
[17] Computed by adding interest expense to net income ıd dividing this sum by total assets.
[18] Commerce, "Quarterly Financial Report for Manu-cturing, Mining, and Trade Corporations", Fourth uarter 1989, p. 134.
[19] This section reflects the views of Wall Street ıalysts and investment bankers based on discussions .at took place in May and June 1990.
[20] Barring strike activity by the United Auto Workers.

According to several of the parties consulted, U.S. producers have been slow to meet end user needs; moreover, foreign customers have also reportedly found U.S. producers unreliable in filling foreign orders in times of strong domestic demand. Several analysts indicated that strong domestic demand for steel has allowed the continued operation of marginal facilities that would otherwise be closed. One analyst surmised that certain facilities, some of which are under new ownership, might not be able to survive a market downturn. Problems were thought to be particularly ominous for companies selling a high percentage of steel to distributors, where price and volume declines might be relatively steep.

Competitiveness

In general, financial analysts commented that the industry had made significant improvement in operations over the last several years. Nevertheless, in comparison to foreign competitors such as Japan and Korea, U.S. producers were cited as lagging in modernization efforts, providing lower quality products on a less timely basis, and operating on significantly higher cost structures (other sections of this report provide an analytical perspective on these issues). Several industry analysts and investment bankers indicated that U.S. producers generally have not developed competitive strategies in response to prevailing worldwide competitive conditions. The Japanese producers, for example, were reportedly willing to take price reductions to increase or maintain market share, whereas U.S. producers were unwilling to do so.

Steel converters, on the other hand, were seen as becoming more competitive as they lower their hourly costs, install new equipment, and increase the quality of their products. Their growth, analysts indicate, reflects the ability to undercut the relatively high costs of the major integrated mills.

Joint Ventures

In general, financial analysts considered the recent formation of joint ventures with foreign steelmakers a positive development for U.S. producers, as they will benefit from capital infusions and technological transfer. Recent investors in the U.S. industry include Japanese, Korean, and French steelmakers.

In terms of future financing, industry analysts expect more joint ventures between U.S. and Japanese producers, particularly in the minimill and specialty steel segments. The perception is that Japanese investors, who are seen as more patient, willingly accept lower rates of return than domestic investors, perhaps because of their lower cost of capital. One analyst cited the example of a recently formed joint venture that is expected to provide a 15-percent return on investment; this falls well below the benchmark 20 percent that is typically required by U.S. investors.

According to one source, consolidation activity among the integrated producers has been completed, although it appears likely that future consolidation might occur within the minimill and specialty producer segments. Consolidation among minimills is seen as likely because there is significant overcapacity to produce merchant bars and other items traditionally produced by the segment. Consolidation in the specialty sector, on the other hand, is occurring as raw steel producers and converters merge.

Future Financing and Bond Ratings

While the industry has made many changes there are still concerns about its future performance and competitiveness. This is indicated by the relatively low rankings assigned to the steel industry's bonds. Despite improvements and strong demand in certain segments, the industry continues to encounter difficulty in raising capital given the number of bankruptcy filings that have occurred. One investment banker cited the example of a recently negotiated project that was likely to generate an above-average return; despite the parent company's return to profitability U.S. investors showed little interest in participation. Japanese clients eventually became the primary investors.

When assigning debt ratings, analysts at Moody's define the intermediate time horizon as 2 to 3 years. The methodology used to assign debt ratings includes consideration of market position, diversity of markets, product lines, and geographic distribution. Additionally, individual business fundamentals are important; Moody's analysts consider cash flow generation, financial background, and cyclical performance when assigning debt ratings.

Bond ratings, as provided by Moody's Investor Service, indicate that no ratings for the individual companies included on table 11 have changed since 1989; as a group they are still below investment grade, trailing other major industries (figure 3). When queried about rating for commercial paper, it was indicated that only two steelmakers, USX and Nucor Corp., had sufficiently high bond ratings (investment grade) to be considered for commercial paper ratings. Both of these firms, especially USX, have significant earnings from nonsteelmaking segments.

Table 11

Moody's ratings to senior debt[1] [2] of selected U.S. steel producers, by specified years, 1982, 1985, 1988, 1989, and Jun. 1990

	As of June				
Firm	*1982*	*[3]1985*	*1988*	*1989*	*1990*
Armco	A	Baa3	B2	Ba3	Ba3
Bethlehem	A	Ba1	Ba3	Ba3	Ba3
Inland	A	Baa2	Ba1	Ba1	Ba1
J & L[4]	Ba	Ba1	Caa	Caa	Caa
National	A	Ba1	Ba3	Ba3	Ba3
Republic[4]	A	Ba1	Caa	Caa	Caa
United States Steel[5]	A	Baa2	Ba1	Baa3	Baa3
LTV Steel	([6])	B1	Caa	Caa	Caa

[1] Moody's ratings of company senior debt are as follows:

Aaa: Best quality and carry smallest degree of risk.
Aa: High quality and together with Aaa, are known as high-grade bonds.
A: Possess many favorable investment attributes and are considered upper-medium grade obligations.

Baa: Medium-grade obligations which are neither highly protected nor poorly secured.
Ba: Obligations which have speculative elements; future cannot be considered well assured.
B: Generally lack characteristics of desirable investment.
Caa: In poor standing; may be in default or may present elements of danger with respect to principal or interest.
Ca: Speculative in a high degree.
C: Lowest rated bonds.

[2] Ratings are of senior debt; those of subordinated debt such as debentures are not shown. Subordinated debentures have historically been ranked lower than the ratings shown here.

[3] Moody's began assigning numerical modifiers to its alphabetic ratings in 1988. 1 is preferable to 2, which is preferable to 3.

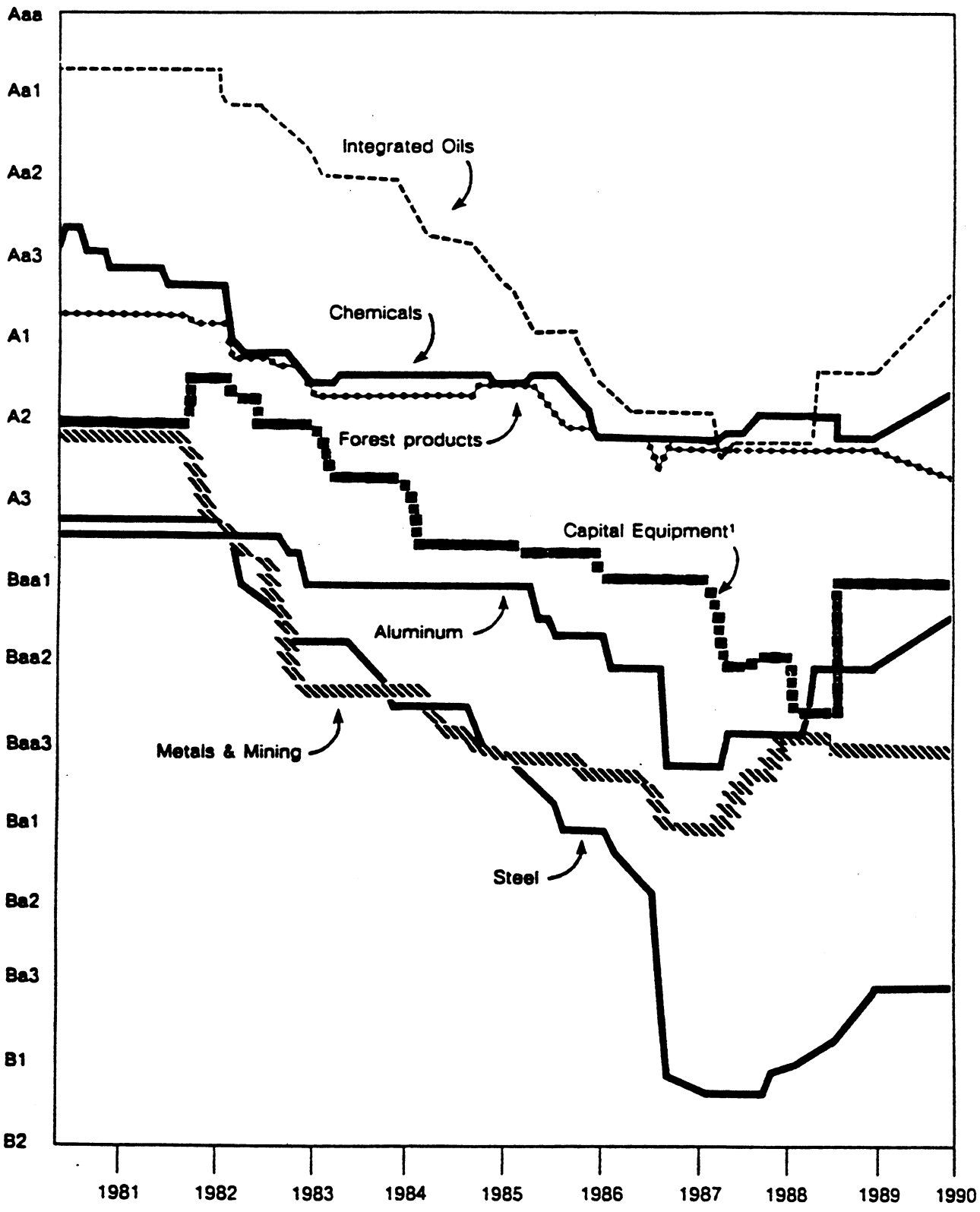
[4] LTV Corp (the holding company) merged Jones and Laughlin (J & L) and Republic Steel to form LTV Steel in 1984. While Moody's assigns a rating of Ca to the holding company, a higher rating of Caa is assigned to the operating companies.

[5] U.S. Steel changed its corporate name to USX Corp. on July 9, 1986 to reflect diversification into nonsteel lines of business.

[6] Not applicable.

Source: Moody's Investors Service, Inc.

Figure 3
Selected industry rating trends, 1981-90



[1] Variation related, because the companies included in the group have changed.
Source: Moody's Investors Service

Steel Consumption

Background

Demand for steel is cyclical in nature, responding to downturns or upswings in the economy as a whole, and in certain key steel-consuming industries in particular (e.g., the automotive and construction industries). The peaks and low points of the cycle are often accentuated by sizeable changes in the steel inventory levels of distributors and end users; the inventories tend to be built up when the market is strong (and prices are rising), and drawn down when the market is weak. This behavior, though seemingly counter-intuitive, occurs primarily because of the impact of pricing changes on the value of inventories and expectations about the availability of steel in the short term.

Although steel demand rose in the second half of the 1980s compared with the first half, it remained well below the peak level attained prior to the first oil shock of 1973, as seen below:

Period	Average annual apparent consumption
1970–1974	109.7
1975–1979	106.0
1980–1984	91.9
1985–1989	96.4

The recession that followed the first oil shock in 1973 significantly reduced demand for steel, and the second round of petroleum price increases in 1979 intensified the downturn.[21] Contributing to the weakness in domestic steel demand in this period was the tendency of many steel-consuming industries to shift production overseas.

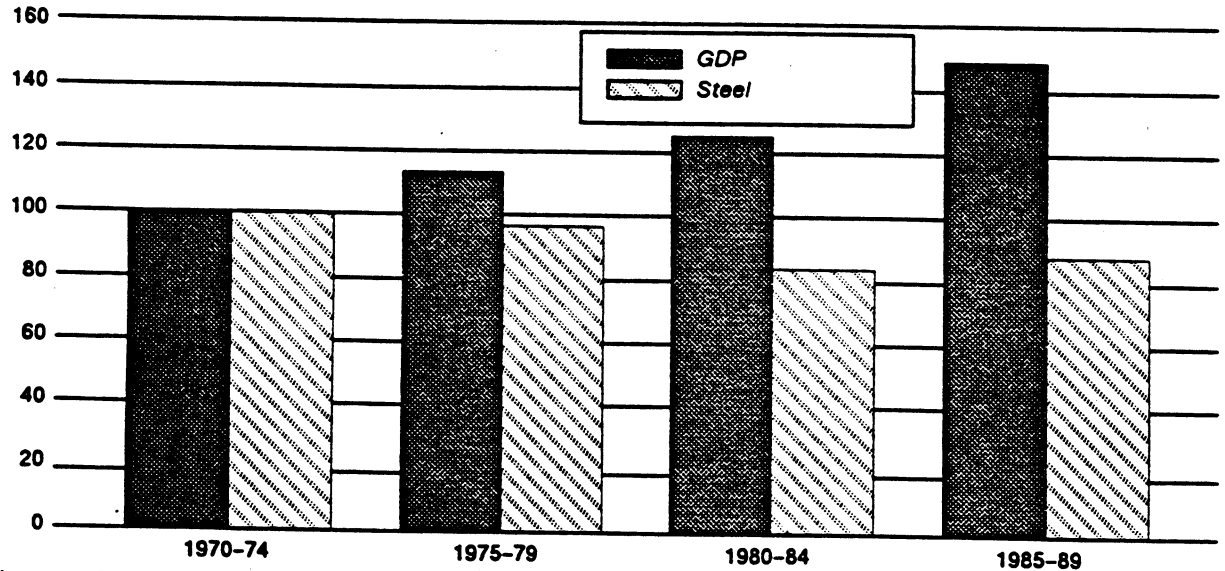
In the last 5 years (1984–89), steel demand rebounded, principally reflecting the long period of sustained economic growth starting in 1982. In addition, certain foreign steel-consuming industries began shifting production to the United States. The Japanese automobile industry, for example, opened several U.S. manufacturing operations in the mid-1980s.

Two other factors have played an important role in shaping the demand for steel since the early 1970s. First, progress in steel technology allowed steel producers to satisfy client needs with lighter steels. In the automotive industry, for example, as consumers became sensitive to fuel efficiency, the steel industry developed lighter steels to reduce the weight of automobiles. Second, steel faced increasing competition from alternate materials, such as aluminum and plastics. These factors contributed to the general decline in the intensity with which steel is used throughout the economy. As shown in figure 4, steel demand contracted as the real U.S. gross domestic product (GDP) climbed steadily.

[21] Producers of certain steel structurals, pipes, and tubes have also experienced the effects of a third disturbance in the oil market, which began in 1982. World oil prices plummeted and steel consumption by the U.S. oil industry, which sharply reduced rig construction, declined considerably.

Figure 4
Index of real gross domestic product and apparent consumption for steel mill products, annual average for specified periods

(Base period = 1970–74)



Source: Compiled from official statistics of the U.S. Department of Commerce, Bureau of Economic Analysis and Bureau of the Census (as published by the American Iron and Steel Institute).

Current

In 1989, led by an upswing in the machinery and construction markets, actual steel consumption is estimated to have reached 96 million tons, representing a slight increase (1 percent) over 1988, which was also a strong year (table 12).

The largest consuming industries for steel are the construction, machinery, and automotive industries. Other significant steel consumers include producers of oil and gas, domestic and commercial equipment, appliances, and containers. Although precise data on individual steel product line consumption by end markets are not available, general trends can be examined by evaluating specific indicators in each market. As shown in table 12, growth in steel demand from the machinery and construction industries supported a small net increase in overall consumption during 1984–89.

The construction industry, steel's largest consuming market, increased its level of steel demand in the past few years despite its recent downturn. One possible explanation for this increase is that the general construction downturn has least affected steel-intensive segments of the industry. For example, spending on private residential construction (in constant dollars) decreased 7 percent from 1988 to 1989, while spending on private nonresidential and public construction, which use steel more intensively, either increased slightly or stayed the same.[22] Other possible factors may be the recent efforts made by steel manufacturers, fabricators, and service centers to improve structural steel's overall market position vis-a-vis reinforced concrete as the load-bearing material for buildings and bridges.[23] Products most affected by trends in the construction market include rebar, plate, and structurals.

In the machinery market, which manufactures equipment for five major sectors (farm, construction, metalworking, general industrial and major electrical), steel consumption increased by an estimated 15 percent from 1984 to 1989 as economic growth increased spending in these areas. Contributing to this spending increase has been the increased competitiveness of the U.S. machinery industry, as reflected in the decline of the industry's trade deficit and the return of production facilities to the United States. Plates, bars, mechanical pipe, and wire rod are steel products most likely to be affected by the upswing in this market.

Steel consumption by the auto industry appears to have dropped off slightly in 1989, reflecting weakening demand, especially in the second half of the year. In general, the trend in steel consumption by the industry appears to follow fairly closely the combined level of U.S. auto and truck production in the 1984–1989 period. As production dropped 6 percent between

[22] *Construction Review*, March/April 1990, p. 3.
[23] See *Monthly Report on the Status of the Steel Industry*, December 1989, pp. i-iii.

Table 12
Steel: Actual consumption by end market, 1984–89

End market	1984	1985	1986	1987	1988	1989
			(millions of short tons)			
Construction	27.1	29.7	28.7	28.5	28.9	29.6
Machinery	21.0	21.1	20.5	21.1	23.2	24.2
Automotive	22.2	22.9	22.1	21.5	22.3	21.5
Oil & Gas	6.8	6.3	3.8	3.5	3.5	3.5
Domestic and commercial eqpt	5.3	5.5	5.5	5.7	5.6	5.6
Appliances	3.6	3.5	3.6	3.7	3.6	3.5
Containers	5.3	5.2	5.1	5.0	5.0	5.0
Rail transportation	2.1	1.8	1.4	1.3	1.5	1.5
Other	1.4	1.4	1.2	1.1	1.3	1.5
Total	94.8	97.4	91.9	91.4	94.9	95.9
			(by percent)			
Construction	28.6	30.5	31.2	31.2	30.5	30.9
Machinery	22.2	21.7	22.3	23.1	24.4	25.2
Automotive	23.4	23.5	24.0	23.5	23.5	22.4
Oil & Gas	7.2	6.5	4.1	3.8	3.7	3.6
Domestic and commercial eqpt	5.6	5.6	6.0	6.2	5.9	5.8
Appliances	3.8	3.6	3.9	4.0	3.8	3.6
Containers	5.6	5.3	5.5	5.5	5.3	5.2
Rail transportation	2.2	1.8	1.5	1.4	1.6	1.6
Other	1.5	1.4	1.3	1.2	1.4	1.6
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Robert Wendt, Bethlehem Steel Corp., paper presented at the Steel Survival Strategies Conference, June 26, 1990.

1985 and 1987, and an additional 4 percent from 1988 to 1989, steel consumed by the industry fell by similar proportions. The major steel products consumed by the auto industry are sheet and strip, including galvanized and other coated steels. Available data indicate that the automakers' demand for galvanized sheet has been least affected by the auto industry's recent downturn.[24]

Among steel-consuming industries, steel demand from the oil and gas industry has declined the most; during 1984–89, steel consumption fell by about 50 percent to 3.5 million tons. This mirrors sharply reduced oil drilling in the United States, where the rig count fell from 1,980 in 1985 to 869 in 1989.[25] Tubular products are the steel products most common in the oil and gas market.

In addition to developments in final consumption, the steel market is affected by actions purchasers take regarding inventory levels. Between 1988 and 1989, for example, final consumption increased, as steel purchases (or apparent consumption) declined by 5 percent, falling from 102.6 to 97.0 million tons. The difference between the two reflects a relatively large inventory buildup of approximately 5 million tons in 1988 (as apparent consumption reached its highest point since 1981) and a decline in inventories of an estimated 800,000 tons in 1989.

Despite the relatively small change in inventory holdings in 1989, inventory levels remain sensitive to expectations, particularly among steel service centers and steel distributors. When steel prices are expected to increase, larger steel inventories are accumulated to derive extra revenue from the appreciation of prices; when prices are expected to decrease, inventories tend to be drawn down in anticipation of lower replacement costs. Additionally, when the market is expected to be strong, service centers, distributors, and end users tend to increase inventory levels in order to assure sufficient supply for future orders.

Outlook

A review of steel forecasts, as well as discussions with industry analysts, suggest that apparent steel demand is likely to continue to decline during 1990, dropping to 92–94 million tons from 97 million tons in 1989. Many analysts believe, however, that the market will begin to strengthen again in the second half of 1990 and that apparent steel consumption in 1991 will increase to 97 million tons. Longer-term forecasts of apparent steel consumption are more difficult to make, as they depend on different assumptions concerning economic growth, the value of the dollar, and the competitive position of substitute materials.

Trade

As discussed below, the role of U.S. foreign trade in steel changed considerably in the late 1980s (table 13). U.S. producers exported more of their shipments in 1989 (5.4 percent) than in any year since 1970 and import penetration in the U.S. market reached its lowest point since 1980 (falling to 17.9 percent). As a result, from 1988 to 1989, the deficit in steel trade declined by one-third in volume terms (6.1 million tons) and by one-quarter in value terms ($2.1 billion). The deficit has continued to decrease through 1990.

Imports

Improvements in U.S. cost competitiveness and relatively strong demand in foreign markets, which reduced interest in exporting to the United States, resulted in a continued decline in U.S. steel imports during 1989 and 1990. In 1989, U.S. imports fell to a 6-year low, declining by 17 percent from the level established in 1988 (figure 5). Imports from Asia, where steel demand was

[24] Whereas U.S. producer shipments of sheet and strip products to the auto industry declined nearly 10 percent in 1989, shipments of galvanized sheet and strip remained constant.

[25] *Monthly Energy Review*, February 1990, p. 64.

Table 13

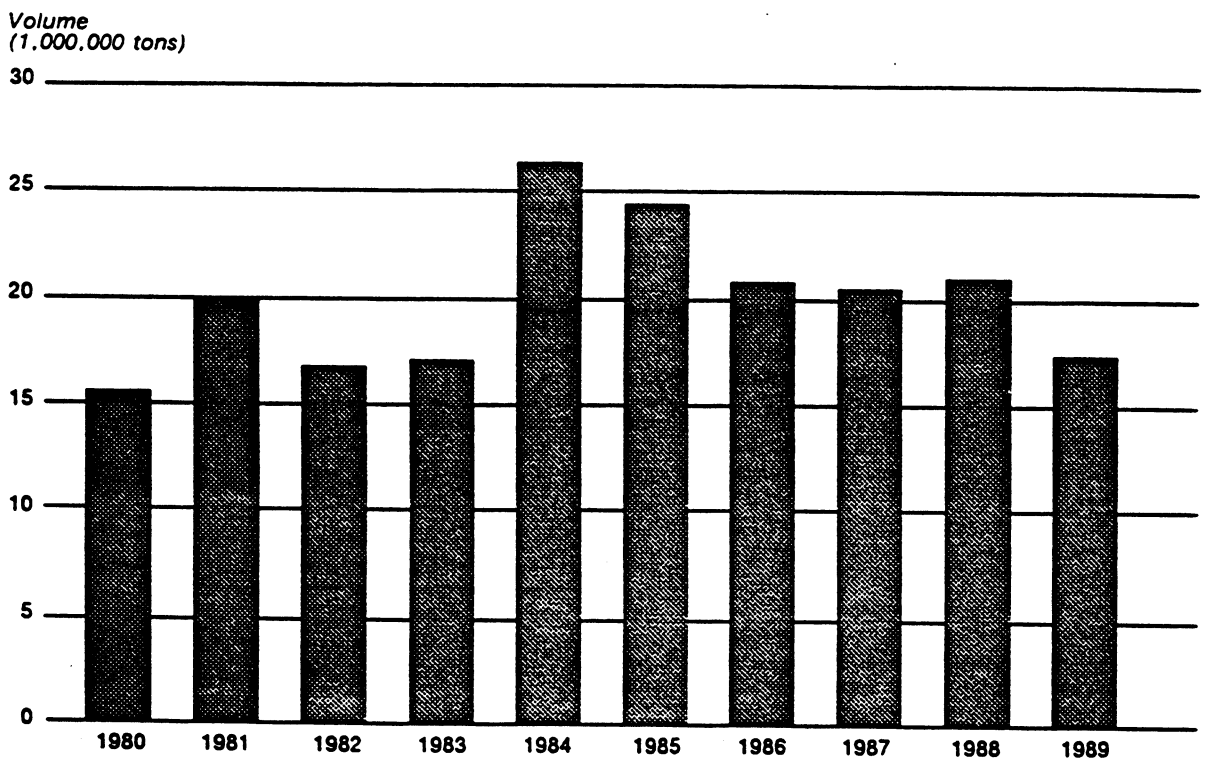
Steel mill products: U.S. imports, exports, import penetration[1], and exports as a percent of shipments, 1984–1989 and January through March 1989–1990

Year	Import penetration	Exports/ shipments	Trade balance	
			Volume	Value
	(Percent)		Million net tons	Billion dollars
1984	26.4	1.3	-25.2	-9.3
1985	25.2	1.3	-23.3	-8.7
1986	23.0	1.3	-19.8	-7.3
1987	21.3	1.5	-19.3	-7.4
1988	20.3	2.5	-18.8	-8.2
1989	17.9	5.4	-12.7	-6.1
January–March, 1989	17.0	4.9	- 4.3	-1.5
January–March, 1990	15.7	4.9	- 3.6	-1.2

[1] Import penetration is defined as imports as a percent of apparent steel consumption.

Source: Compiled from official statistics of the U.S. Department of Commerce and the American Iron and Steel Institute.

Figure 5
Steel mill products: U.S. imports, 1980-89



Source: Official statistics of the U.S. Department of Commerce as published by the American Iron and Steel Institute.

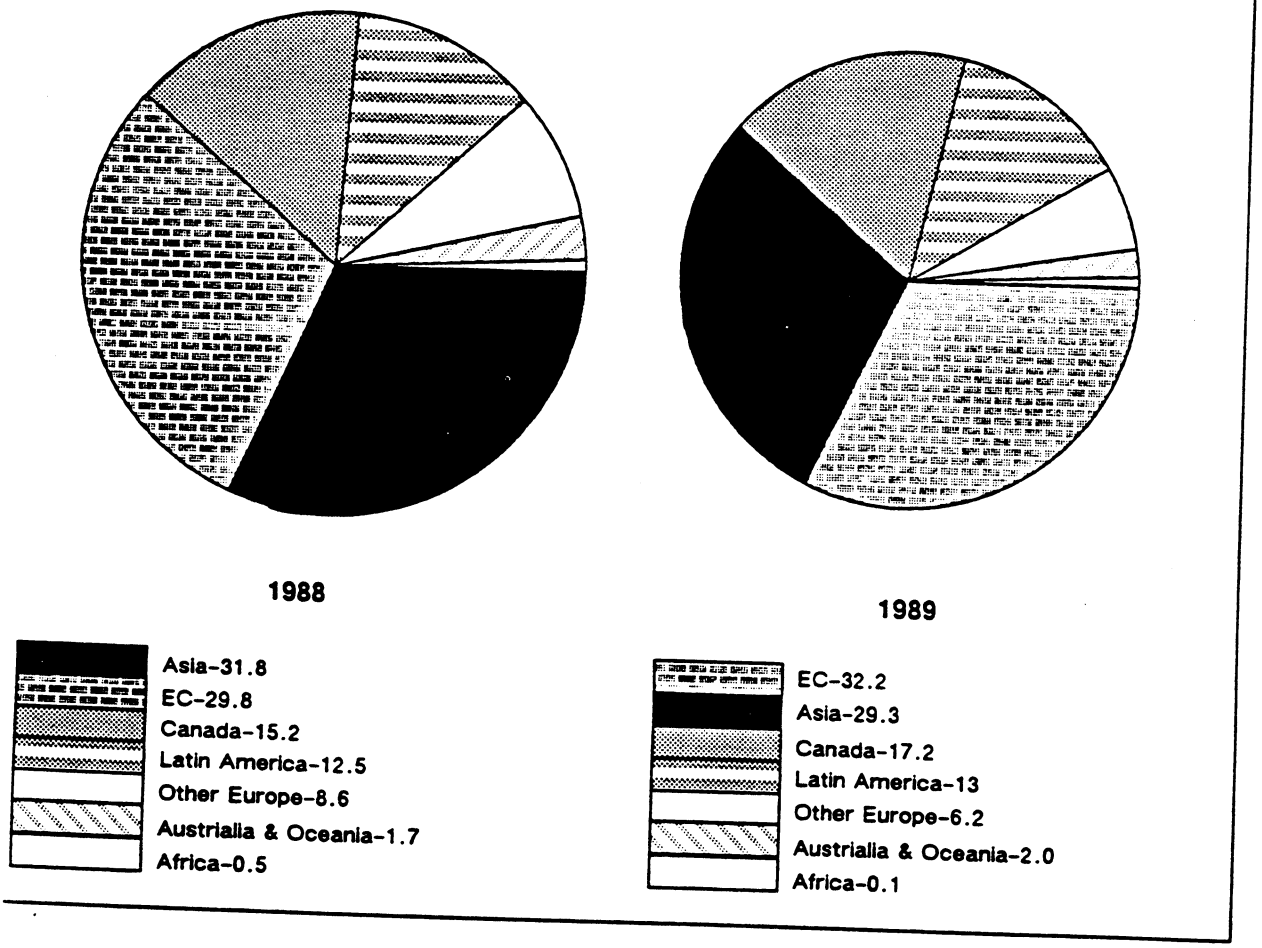
strong, accounted for the largest absolute and relative declines, as these imports fell by 24 percent, to 5.1 million tons (figure 6). The decline continued in 1990, as imports during January–April were 12 percent below their January–April 1989 level.

The product mix of U.S. imports remained fairly constant during 1988–89 as imports of each of the carbon steel product lines (with the exception of rails and wire products) declined (see appendix D–5). Certain high value-added subcategories experienced increases; imports of tin mill products and electrogalvanized steel, for example, rose 9 percent and 17 percent, respectively. Increased imports of electrogalvanized steel reflected increased demand for corrosion-resistant material from downstream industries such as the automotive industry. Stainless and alloy tool steel imports also increased (by 9 percent). These increases, combined with strengthening market conditions (and higher prices) in the first half of 1989, resulted in an 11-percent increase in the unit value of imports (to $535/ton, where it has remained for the first 4 months of 1990).[26]

With respect to the distinction between VRA and non-VRA trade, imports from VRA countries comprised 74 percent of total imports in 1989, representing a slight increase from the previous 2 years (table 14). Although non-VRA suppliers continued to have a large presence in certain product markets (e.g., those for bars, wire and wire products, and tool steel), overall U.S. imports from such suppliers diminished by 27 percent. Imports from Canada, by far the largest non-VRA foreign supplier, fell by a relatively small amount (6 percent). As a result, in 1989 (as tariff reductions from the United States-Canada Free Trade Agreement took effect), Canadian steel imports represented 68 percent of non-VRA imports, compared to only 53 percent in 1988.

[26] U.S. International Trade Commission, *Monthly Report on the Status of the Steel Industry*, Publication 2298, July 1990, pp. 7-8.

Figure 6
Steel mill products: U.S. imports by country or region of origin, by percent, 1988, 1989



Source: Official statistics of the U.S. Department of Commerce as published by the American Iron and Steel Institute.

Table 14
Steel mill products and certain fabricated steel products: Imports from VRA countries as a percent of total imports, 1984-1989

(Percent)

	1984	1985	1986	1987	1988	1989
All grades of steel:						
Average	83	81	75	69	71	74
Carbon & certain alloy steel:						
Semifinished	65	83	75	77	80	93
Plate	81	82	75	57	59	71
Sheet and strip	86	86	86	80	81	83
Bars & certain shapes	74	69	47	45	45	49
Wire rod	71	65	58	50	51	50
Wire	69	66	60	59	57	53
Wire products	84	80	67	61	61	62
Structural shapes & units	84	81	74	76	79	79
Rails & related products	82	85	69	55	45	49
Pipe and tube	89	83	74	59	66	68
Average, carbon	83	81	75	69	71	74
Stainless steel:						
Semifinished	86	78	26	42	23	24
Plate	79	92	89	84	80	88
Sheet and strip	91	93	89	90	90	94
Bars & certain shapes	90	88	88	87	86	89
Wire rod	82	80	79	78	83	83
Wire	79	79	65	67	68	66
Pipe and tube	70	72	53	51	48	62
Tool steel (all forms)	62	60	63	54	53	59
Average, stainless and tool	84	84	77	72	67	73

Source: U.S. International Trade Commission. Monthly Report on the Status of the Steel Industry, Publication 2298, July 1990.

Exports

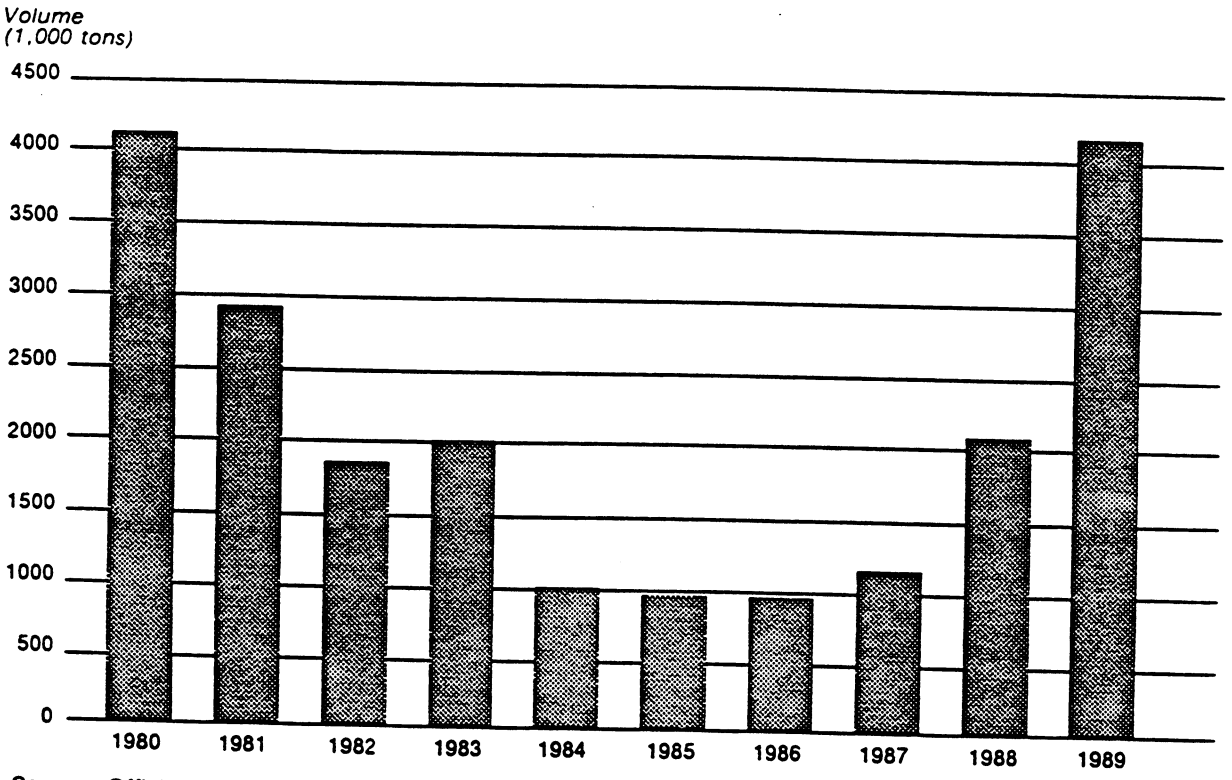
U.S. exports of steel mill products reached their highest point of the decade in 1989, more than doubling from 1988 (figure 7). The same factors that resulted in a decline in steel imports—successful restructuring, favorable exchange rates, and strong steel demand in Japan and other Pacific Rim countries—also spurred growth in exports. Despite the increase, U.S. exports remain small compared to those of other major steel-producing regions, both in absolute terms and as a percentage of shipments (see Trends and Developments in the International Steel Industry).

The primary focus in export markets in 1989 shifted away from neighboring Canada and Mexico towards Asia. In 1989, shipments to Asia were two-and-one-half times greater than in 1988, representing more than one-half of total U.S. exports during 1989, compared to less than one-third in 1988 (figure 8). This reflects not only the increase in exports to Japan and Korea (where demand was high), but also to China, where Japanese producers reduced their presence. As a result of these shifts, Korea, China, and Japan accounted for larger shares of total U.S. steel exports: Korea's share increased from 2 [illegible]cent to 16 percent (becoming the largest sing[illegible]port market); China's, from 5 percent to 9 pe[illegible]t; and Japan's, from 10 to 13 percent. Exports to Canada and Mexico continued to grow in absolute terms, although their combined share of total U.S. exports fell from 49 percent to 24 percent. Exports to the EC increased 44 percer but declined as a percentage of total steel expor (from 12 percent to 8 percent).

Shipments to Japan and other Pacific Ri countries were primarily comprised of low value-added products. For example, the increa in exports of semifinished steel was due largely a 13-fold increase in shipments to Asia from 19 to 1989. Shipments of high value-added pro ucts, on the other hand, were principally directe to nonmarket economies (e.g. Soviet Union ar China) and to Mexico. Oil country tubular goo (OCTG), cold-rolled sheet, and galvanized she and strip provide examples of the trend in hi value-added exports. The four-fold increase OCTG exports was due almost entirely to the ri in shipments to China and the Soviet Unio which had previously purchased only a small po tion of U.S.-produced OCTG. Cold-rolled she exports, which rose more than seven-fold fro 1988 to 1989, were principally shipped to Mexi and China, both of which had been relative small recipients of U.S. products in 1988. I 1989, these exports alone comprised over 6 pe cent of total U.S. exports. Galvanized sheet ar strip exports increased 66 percent to rea 444,000 in 1989; nearly half of these expor were shipped to either China or the Soviet Unio

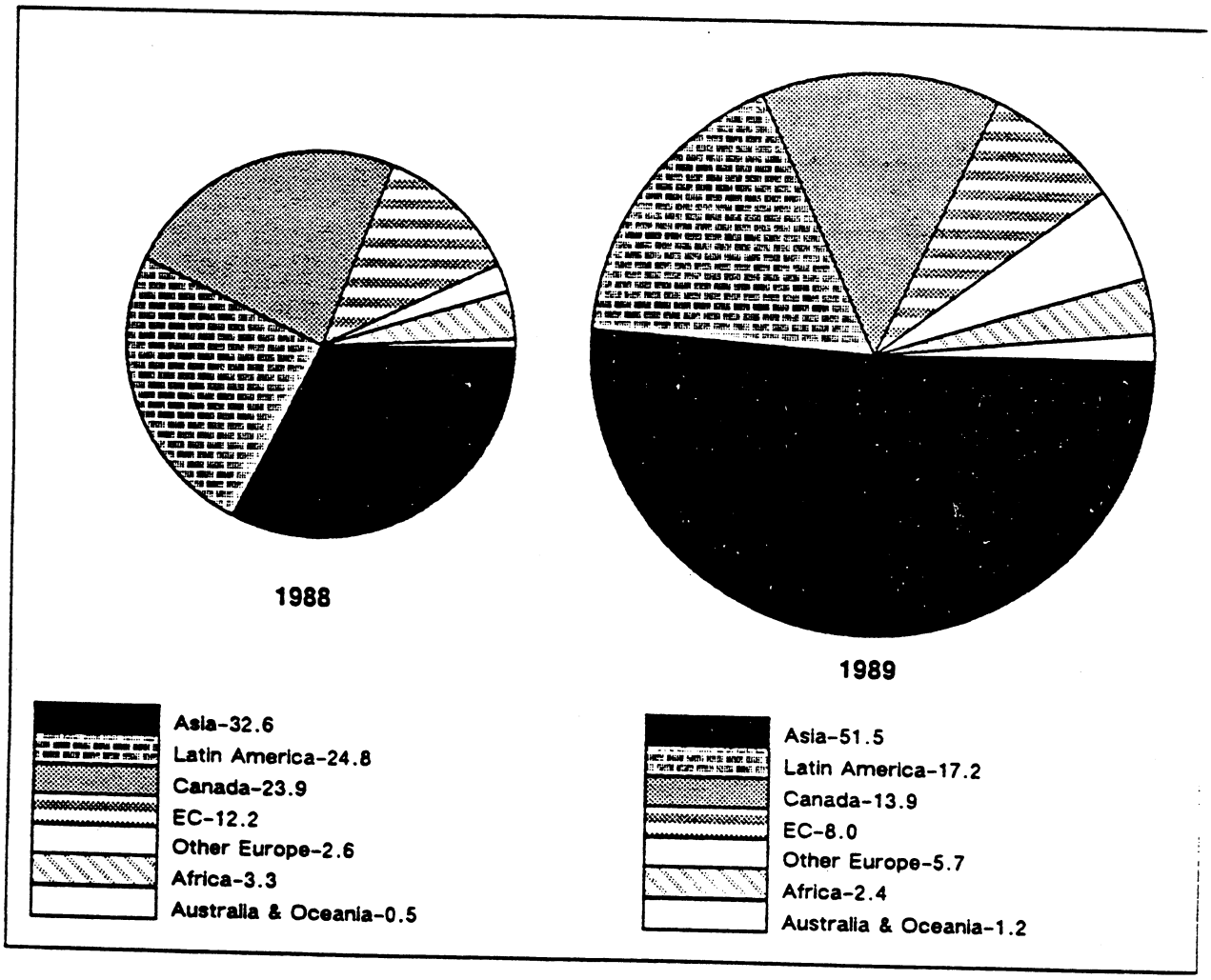
Although exports in all categories of ste products increased, low value-added exports ro faster than high-value added products (see a pendix D, table D-6). As a result, the unit val of steel exports declined by 22 percent in 198

Figure 7
Steel mill products: U.S. exports, 1980-89



Source: Official statistics of the U.S. Department of Commerce as published by the American Iron and Steel Institute.

Figure 8
Steel mill products: U.S. exports by country or region of destination, by percent, 1988, 1989



Source: Official statistics of the U.S. Department of Commerce as published by the American Iron Steel Institute.

to $611 per ton, a level that appeared essentially unchanged during January–March 1990 (at $603 per ton).

Steel Pricing

Producer Prices

Reflecting a relatively strong market in the first half of the year and a weak market in the second half, producer prices in 1989 first rose and then fell. Overall. prices increased 3.4 percent in 1989, compared to 5.0 percent for manufacturing industries as a group (table 15).

The program of VRAs, which were largely nonbinding in 1989,[27] appeared to have had little impact on prices during the year. Rather, the weakening of steel producer prices which began in the second half of 1989 reflected a downturn in economic activity, particularly among major steel-consumers, such as the automotive industry (see Steel Consumption). As seen in the tabulation below, prices continued to decline through March 1990, representing a decrease of 2.3 percent from their March 1989 level.

Period	*Price Index*
December 1988	112.7
March 1989	115.1
June 1989	115.1
September 1989	114.4
December 1989	114.0
March 1990	112.4

[27] Most country or regional quotas were less than 70 percent filled, principally reflecting a shift in foreign producers' interest away from the United States and toward other markets (such as those in Asia) where they could obtain higher prices.

Table 15

Steel: Index of producer prices for steel mill products, all manufacturing industries, and finished goods, annual averages, 1984-89

(1986 = 100.0)

Item	1984	1985	1986	1987	1988	1989
Steel mill products	104.9	104.9	100.0	102.5	110.9	114.7
All manufacturing industries	(1)	(1)	100.0	102.5	106.1	111.4
Finished goods	100.5	101.5	100.0	102.1	104.7	110.1

[1] Not available.

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

Before the downturn, prices had risen steadily from a low point in 1986. The rate of increase peaked in 1988, as year end prices were 8 percent higher than at year-end 1987. Further increases occurred in 1989, although the rate of increase was lower; by year-end 1989, prices were 1.3 percent above their 1988 year-end level.

The general trend appears to apply to each of the major product categories for which data are available (table 16). The percentage price change in 1989 was substantially higher than the average in some cases (e.g., stainless cold-rolled strip) and lower in others (e.g., hot-rolled bars, plates, and structurals), but in no case did the increase match that of the previous year.

Purchaser Prices

Because the producer pricing data represent averages, they do not provide insights into variation in prices paid by steel consumers. Such variation was a topic of considerable comment during 1989, when the VRA program was under review.[28] To assist in developing an appreciation of the extent to which price variation occurs, data were collected from a sample of large and small purchasers from a broad spectrum of industries.

The experience of steel consumers varied considerably in 1989 (table 17 and appendix D, tables D-7 through D-12). The percentage of steel purchasers that reported substantial increases in prices was about the same as the percentage that reported decreases. Steel purchasers in the stainless steel market appear to have experienced the widest variation in steel price changes, whereas those in the wire rod market appear to have faced the least variation.

The wide disparity is a reflection of several factors, including divergent regional and product market conditions, different purchase conditions (e.g., spot market, short-term contract, long-term contract), and variant market power among steel consumers.

[28] For a discussion of the price effects of the VRAs during 1985-88, see: USITC, *The Effects of the Steel Voluntary Restraint Agreements on U.S. Steel-Consuming Industries*, Inv. No. 332-270, May 1989.

Table 16

Steel: Index of producer prices, annual averages, 1984-89

(1984 = 100.0)

Item	1984	1985	1986	1987	1988	1989
Steel mill products	100.0	100.0	95.3	97.7	105.7	109.4
Semi-finished	100.0	99.9	98.7	99.7	108.7	112.8
Hot-rolled sheet and strip	100.0	101.0	97.5	100.7	105.9	110.3
Cold-rolled sheet and strip, carbon	100.0	99.1	93.8	97.6	105.6	110.2
Hot-rolled bars, plates and structurals	100.0	100.3	92.8	95.4	108.2	110.0
Cold-finished bars	100.0	97.2	93.6	93.0	98.0	99.2
Pipe and tube	100.0	99.0	94.9	96.5	105.4	108.9
Cold-rolled strip, stainless	100.0	96.6	98.5	99.7	107.0	111.7
Cold-finished bars, stainless	100.0	100.1	97.0	93.5	109.8	111.7

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

Table 17
Steel: Changes in end of quarter prices as reported by purchasers, fourth quarter 1988 to first quarter 1990, by product

Item	Sheet and strip	Plate and structurals	Bars	Wire and wire rod	Pipe and tube	Stainless
	percent of respondents					
Price changes (P):						
-12.5% ≥ P	2	2	3	3	1	5
- 7.5% ≥ P > -12.5%	4	3	3	6	7	0
- 2.5% ≥ P > -7.5%	24	14	21	18	25	17
2.5% ≥ P > -2.5%	36	32	34	51	38	27
7.5% ≥ P > 2.5%	17	20	18	16	17	20
12.5% ≥ P > 7.5%	9	17	13	4	7	15
P > 12.5%	8	11	6	1	5	17
Survey sample:						
Number of respondents	179	82	105	68	84	83
Number of price series[1]	343	177	203	101	149	157

[1] A number of respondents provided data on more than one product. Moreover, some respondents provided separate data on spot and contract prices; data sets on spot and contract prices were included where they represented more than 15 percent of a company's purchases.

Note.—Due to rounding, percentages may not add to 100.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Industry Efforts to Adjust and Modernize

The efforts of the U.S. steel industry to adjust to domestic and international competition have included actions to lower input costs, modernize facilities, alter corporate structure, and improve both products and customer service. The high levels of investment spending, which started in the mid-1980s, continued in 1989 as most companies purchased new equipment for new or upgraded facilities. New operating methods and equipment improvements have significantly lowered operating costs in several areas, especially in such "hot end" processes as ironmaking (i.e., blast furnaces), steelmaking, and continuous casting. However, increased costs in the areas of wages, worker and retiree health care, and pollution abatement requirements are projected for the near future. Some of these costs, while expected to be significant, are not quantifiable at the current time and have led to some uncertainty among investors and creditors, especially in domestic markets. One result of this uncertainty is the perception of increased risk, which companies have sought to share by initiating joint ventures and innovative financing methods.

Input Costs

Total production costs, the primary components of which are raw materials and labor, are estimated by one analyst to have declined by approximately 10 percent ($54 per ton) since 1984.[29] Through the installation of new equipment, and by modifying their steelmaking techniques and the types of raw materials used in steelmaking, companies continue to increase the productivity of existing facilities. The effec are most notable with respect to blast furnace o erations, where changes in iron ore, coal, an ferroalloys use have occurred. With regard raw materials, further cost reductions can be a ticipated in light of ongoing actions th companies are taking to increase the efficiency their production. The outlook with respect to l bor is less clear; new labor contracts negotiat during 1989–90 with a number of steel compani reinstated certain pay and benefit concessio and granted pay increases over a multiyear peri (see discussion, "Labor Agreements"). The settlements could raise labor costs by about percent, or in the vicinity of $30 per hour, 1993. The net effect on total production costs uncertain (see Industry Conditions).

Iron Ore

Increased use of fluxed pellets[30] has ma blast furnace operations more efficient by increa ing blast furnace refractory life, reducing ener and coking coal consumption, improving h metal quality, and eliminating the problem handling limestone.[31] Since the capacity of f naces that consume fluxed pellets can increased by as much as 50 to 100 percent, there could be a decrease in the number of bl furnaces in operation without a decrease in pr duction. Consequently, steelmaking compani could reduce the amount of capital expenditur made for building and maintaining blast furnac and lower production costs by increasing the u of fluxed pellets. Consumption of fluxed pelle which accounted for about 25 percent of iron c pellet production in 1988 and 37 percent in 19 could rise to well over 50 percent in 1990.

[29] Paine Webber, World Steel Dynamics, *Steel Strategist #16*, Dec. 1989, Table 6.

[30] Fluxed iron ore pellets are produced by adding calcium or magnesium to the iron ore concentrates.

[31] George W. Hess, "Is the Blast Furnace in its Twilight?" *Iron Age*, November 1987, p. 18.

[32] *Ibid.*

In addition, improvements in iron ore operations have improved the competitiveness of the U.S. steel industry. As a result of the rationalization of inefficient capacity, workforce reductions, and technological improvements (particularly with respect to beneficiation[33] techniques), the iron ore industry reportedly reduced its unit cost of production by 33 percent between 1982 and 1989.[34]

Coal and Coke

Companies are exploring new technologies to produce coke, the primary energy source in blast furnaces. The issue is of particular importance in light of the dated condition of the country's coke ovens, and the projected cost of modifying these ovens to meet new environmental standards. If certain provisions of the proposed Clean Air Act become law, a large portion of U.S. cokemaking facilities could be forced to shut down within the next 10 years.[35]

Steelmaking companies are also examining the feasibility of injecting pulverized or granulated coal into blast furnaces in lieu of natural gas and coke. Reportedly, up to 30 percent of the coke currently used in blast furnaces can be replaced by coal injection,[36] with cost savings of $3 to $10 per ton of raw steel.[37] While the process is not new, the economics have become more attractive in recent years because of changes in the relative costs of coke and coal injection. Currently, the cost of coal injection (including amortization of the pulverizing equipment) is about 50 to 60 percent of the cost of coke.[38]

Armco is the only U.S. steelmaking company which has been using coal injection at its facilities. However, most of the major U.S. integrated steel companies are evaluating coal injection technology and reportedly plan to have pulverized coal injection technology installed on some of their blast furnaces within several years.[39] Such companies include LTV Steel Company, U.S. Steel Corp., National Steel Corporation, Bethlehem Steel Corp., Inland Steel Co., and Weirton Steel Corp.

By comparison, foreign steelmakers, principally located in Western Europe and Japan, use coal injection at 43 locations.[40] Japanese steel companies, for instance, have used coal injection in 45 percent of that country's operating furnaces since 1988.[41] It is estimated by various engineering contractors that 50 percent or more of European capacity will be using this technology by mid-1991.[42]

[33] Beneficiation refers to the upgrading of the metallic content of an ore or concentrate. With regard to iron ore, beneficiation raises the iron content to over 60 percent.

[34] American Iron Ore Association, *U.S. Iron Ore Industry Improvements Impacting the U.S. Steel Industry*, Letter, March 30, 1990.

[35] American Iron and Steel Institute, "Steel Industry Coke Ovens Still Imperiled by Senate Clean Air Compromise," News Release dated Mar. 8, 1990.

[36] Telephone conversation between the staff of the USITC and engineering personnel with Armco, Inc. on Mar. 16, 1990.

[37] *Ibid.*

[38] As calculated from data presented in George C. McManus, "Coal Gets a New Shot," *Iron Age*, Jan. 1989, p. 31.

[39] Hess, *Iron Age*, Nov. 1989, p. 22 and George C. McManus, "Steel's Giving Coal Injection a Shot," Iron Age, May 1990, p. 34.

[40] McManus, *Iron Age*, Jan. 1989, p. 31,.

[41] *Japan's Iron and Steel Industry*, 1988, Kawata Publicity Inc., 1988, p. 80.

[42] Memorandum from Bob Unsworth, Industrial Economics Inc. to the Environmental Protection Agency, January 4, 1990.

Table 18
Steel: U.S. producers' capital expenditures and share of expenditures accounted for by various facilities, by type of producer, 1989

Item	Integrated producers	Specialty producers	Minimill producers	Converters
	Percent			
Steelmaking and casting	[1]32	[2]33	[2]37	([3])
Uncoated flat-rolled[3] [4]	47	53	16	23
Coated flat-rolled	6	0	0	7
Long products[5]	2	7	35	17
Pipe and tube	2	1	4	31
Wire and wire products	0	1	1	9
Other[6]	11	5	6	12

[1] Includes expenditures for cokemaking, ironmaking, and secondary steelmaking facilities.
[2] Includes expenditures for secondary steelmaking facilities.
[3] Not applicable.
[4] Includes expenditures for facilities which produce hot-rolled sheet and strip, cold-rolled sheet and strip, or plate.
[5] Includes expenditures for facilities which produce hot-finished and cold-finished bars, light structurals, wire rods, rails and related products, or medium and heavy structurals (those with cross sections greater than 3 inches).
[6] Includes expenditures which companies could not allocate to product groups.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Ferroalloys

Ferroalloys are principally used as additives to steel to enhance properties such as hardenability, corrosion resistance, and strength. In 1989 the steel industry consumed an estimated $1.1 billion of ferroalloys in the production of steel products.

Cost reductions in alloying operations have been achieved through the efforts of both the steel industry and the ferroalloys industry. The steel industry uses ferroalloys more efficiently because of the development of secondary steelmaking techniques such as vacuum degassing and other ladle metallurgy equipment that improve the yield of the ferroalloy in a batch of steel.[43] For example, manganese and chromium consumption has been cut by 6 percent and 1 percent, respectively, by the use of such equipment.[44] Given the high costs of these alloys, such actions represent a measurable (although relatively small) savings in production costs.

In addition, the ferroalloy industry has developed new products to aid the steel industry in lowering raw material costs. Such products include "Gransil," an ultra low carbon ferrosilicon product, and "Nitrovan," which is a product composed of nitrogen and vanadium. The production process used to produce Gransil requires 5- to 10-percent less raw material to produce a unit of ferrosilicon, thereby yielding a lower cost product.[45] Nitrovan can decrease the use of vanadium by up to 20 percent while improving steel quality and reducing cost.[46]

Other

Steelmakers also have made efforts to improve blast furnace operations. In 1989, more than 15 blast furnaces were upgraded, mainly through furnace relines and rebuilds.[47] Significant increases in efficiency and longevity have been achieved through such rebuilds. For example, a reworked cooling system at LTV's Indiana Harbor H-4 furnace increased daily ironmaking capacity by 16 percent, to 5,200 tons.[48] An improved cooling system, coupled with necessary stack repairs at the "J" furnace at Bethlehem's Sparrows Point plant, is expected to increase daily iron output by over 20 percent, to 4,000 tons.[49] Blast furnace life can also be increased b use of new refractory lining materials. Some esti mates cite a doubling of useful life, to 20 years between relines or major repairs.

Modernization

Domestic steel producers and converters di rected investment toward improving thei competitive position in market niches, rather tha across the entire spectrum of steel mill products reflecting market retrenchment among some pro ducers and market entry among others Integrated and specialty producers continued t focus investment on modernization programs de signed to improve the quality of the flat-rolle products, such as sheet and strip (table 18) Minimills primarily steered investment toward th modernization of meltshops and facilities de signed to produce traditional long products suc as merchant bars, light structurals, and wire rods In addition, minimills also undertook significar investment programs intended to expand into th higher value-added markets for flat-rolled prod ucts, such as sheet, certain long products, large structurals, and special quality bar. Steel conver ers, on the other hand, focused on the improve ment of facilities designed to produce their nich products, such as pipe and cold-rolled and coate sheet.

During 1989, the domestic steel industry in vested $3.2 billion in the modernization of it facilities, with integrated producers accounting fc 67 percent ($2.1 billion) of capital expenditures minimills, 19 percent ($603 million); steel cor verters, 8 percent ($256 million); and specialt mills, 5 percent ($171 million).

Capital expenditures made in facilities prc ducing carbon and specialty steel are presented i table 19 and appendix D, tables D-13 and D-14 Capital expenditures made during the first quarte of 1990 are detailed in appendix D (tables D-1 and D-16).

Integrated Steelmakers

The major mills followed investment strategie intended to enhance their competitiveness in th high value-added markets for hot- and cold-rolle sheet and strip; such investment accounted fc about 47 percent ($1 billion) of the integrate mills' total capital expenditures. Common moc ernization efforts included the installation c vacuum degassing facilities, which produce ultra low carbon steels with superior formability continuous processing lines, which endow ste with greater uniformity; and equipment designe to ensure that hot- and cold-rolling mills produc sheet which meets demanding metallurgical an surface specifications.[50] The major mills mad

[43] Telephone conversation between the staff of the USITC and engineering personnel at Bethlehem Steel Corp. on May 15, 1990.
[44] Telephone conversation between the staff of the USITC and engineering personnel at Republic Engineered Steels, Canton, OH on May 15, 1990.
[45] Telephone conversation between the staff of the USITC and the marketing department of Elkem Metals Co., a domestic ferroalloys producer, on May 15, 1990.
[46] Telephone conversation between the staff of the USITC and the sales department of Shield Alloys Co. on May 15, 1990.
[47] Charles J. Labee and Norman L. Samways, "Developments in the Iron and Steel Industry, U.S. and Canada 1989," *Iron and Steel Engineer*, February 1990, p. D-4.
[48] Hess, *Iron Age*, November 1989, p. 17.
[49] Ibid., p. 24.
[50] Charles J. Labee and Norman L. Samways, "Developments in the Iron and Steel Industry U.S. and Canada - 1989," *Iron and Steel Engineer*, February 1990, pp. D-3 D-4.

ıble 19
eel: U.S. producers' capital expenditures, 1989

;m	Capital expenditures[1] [2]	Share of total capital expenditures
	(1,000 dollars)	(Percent)
ırbon and certain alloy steel:		
ɔkemaking facilities	123,068	4
ɔnmaking facilities	227,641	8
eelmaking facilities[3]	568,723	19
oducts:		
ıeets and strip[4]	1,289,577	43
ates	51,546	2
ars and light structurals	161,958	5
edium and heavy structurals[5]	104,111	3
pes and tubes	143,372	5
ire rod, wire, and wire products	53,870	2
ther[6]	310,271	10
Total	3,034,137	[7]100
:ainless and alloy tool steel:		
:eelmaking facilities[8]	34,744	28
oducts:		
ıeets and strip	56,548	45
ates	7,675	6
ars and light structurals	11,442	9
pes and tubes	2,436	2
ire rods, wire, and wire products	4,178	3
ther[9]	9,238	7
Total	126,261	100
Grand total	3,160,398	([10])

[1] Includes expenditures for the specific type of facility as well as related facilities.
[2] Includes expenditures for pollution control and occupational safety and health (OSH).
[3] Includes expenditures for casting and secondary steelmaking facilities.
[4] Includes expenditures for galvanizing and other coating facilities.
[5] Structural shapes with a cross section exceeding 3 inches.
[6] Includes expenditures on rails and related products as well as expenditures which companies could not allocate ɔ product groups.
[7] Percentages do not sum to 100 percent because of rounding.
[8] Includes expenditures for secondary steelmaking facilities.
[9] Includes expenditures which companies could not allocate to product groups.
[10] Not applicable.

ource: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

elatively low investment in facilities producing ɔng products, such as bars and structurals.

Reflecting the migration toward the high alue-added markets undertaken by the inte- rated producers was the announcement and onstruction of a number of new sheet coating fa- ilities during 1989 (table 20). Coating facilities uch as hot dip galvanizing and electrogalvanizing .nes improve the corrosion-resistance of steel ɔroducts. In aggregate, nearly 1 million tons of lectrogalvanizing capacity is being added at a ost of over $500 million by U.S. producers, and ıore than 2 million tons of hot-dip galvanizing apacity is being constructed at a cost in excess of 300 million.

Specialty Steelmakers

Specialty steel producers underwent a broad ange of investment programs during 1989. The ıodernization of existing sheet and plate mills ac- ounted for 53 percent of the specialty mills' apital expenditures. Computerized systems de- igned to measure and modify gauge, tension, and ooling or eliminate crown were installed in a number of rolling mills, including Armco Specialty Steel (Butler, PA), Coshocton Stainless (Coshocton, OH), and Teledyne Rodney Metals (New Bedford, MA).[51] Tube mills, slitting lines, and paint lines were installed as well.

Specialty mills' expenditures on electric furnaces, which represented 33 percent ($56.5 million) of total expenditures, included the installation of oxy-fuel burners, oxygen lances, bottom stirring, and eccentric bottom tapping systems on existing furnaces. Such programs are designed to reduce both electricity costs and the time required for melting, and to improve the quality of molten steel.

Minimills

Minimills, most of which produce merchant grade bars and light structurals,[52] principally fo-

[51] Labee and Samways, pp. D-36 D-37.
[52] For a detailed treatment of minimills which manufacture products other than merchant grade long products, please see: USITC, *Annual Survey Concerning Competitive Conditions in the Steel Industry and Industry Efforts to Adjust and Modernize*, Inv. No. 332-209, October 1989, pp. 22-24.

Table 20
Steel: New domestic sheet coating facilities announced in 1989

Company	Location (State)	Type of facility	Cost	Annual capacity	Start-up Date
			(million dollars)	(1,000 tons)	
ASC, L.P.[1]	OH	Electrogalvanizing	116	290	1991
L/S Electro Galvanizing[2]	OH	Electrogalvanizing200	360	1991	
I/N Kote[3]	IN	Electrogalvanizing, Hot dip galvanizing	450	900	1991
Bethlehem	IN	Hot dip galvanizing, galvannealing	([4])	450	1992
Bethlehem	MD	Hot dip galvanizing, Galvaluming	([4])	260	1992
Bethlehem	([5])	Hot dip galvanizing, Galvaluming	([4])	260	([6])
NexTech[7]	PA	Hot dip galvanizing	20	100	1990
USS/Kobe[8]	([9])	Hot dip galvanizing, galvannealing	([10])	600	1992

[1] Armco Steel's joint venture with Kawasaki Steel.
[2] LTV's joint venture with Sumitomo Metal Industries.
[3] Inland's joint venture with Nippon Steel.
[4] The joint cost of Bethlehem's three coating lines is estimated at $300 million.
[5] The exact location of this facility remains undisclosed, although Bethlehem has indicated that it will be located in the South or Southwestern United States.
[6] After the start-up of the Maryland facility.
[7] Operated by an investor group led by Metaltech (Pittsburgh, PA) in cooperation with the Regional Industrial Development Corp. of Southwestern Pennsylvania.
[8] US Steel's joint venture with Kobe Steel.
[9] The location of this facility remains undisclosed.
[10] The cost of this facility remains undisclosed.

Source: *Iron and Steel Engineer*, February 1990.

cused their capital expenditures on electric arc furnaces, which accounted for 37 percent ($226 million) of expenditures. Birmingham Steel's Kankakee, IL, Works and Cascade Steel Rolling Mills (McMinnville, OR), for example, constructed entirely new meltshops to replace existing ones. In addition, nontraditional melting technologies were implemented in a number of mills. Charter Manufacturing (Saukville, WI) and Florida Steel's Tampa, FL, facility installed direct current electric furnaces,[53] which reduce electrode and refractory consumption, and Ocean State Steel (East Providence, RI) installed an energy optimizing furnace (EOF), which uses chemical energy created by the reaction of coal and oxygen in order to melt scrap.[54]

Reflecting the product mix of traditional minimills and the recent advance of minimills participating in nontraditional markets, capital expenditures in the minimills' bar and structural facilities accounted for 35 percent ($210.3 million) of total expenditures. Principally resulting from some minimills' penetration of the market for medium and heavy structurals, minimill expenditures on structural mills far exceeded investments by the integrated mills. Minimill expenditures on facilities that produce flat-rolled steel principally reflect the large investments recently made by Nucor, which began producing sheet products at its Crawfordsville, IN, facility during 1989, and Oregon Steel Mills, which primarily produces plate.

Steel Converters

Steel converters' capital expenditures also reflected their principal market concentration: the processing of steel mill products which use relatively less capital intensive production processes. The converters' largest investment item was made in welded pipe facilities, which accounted for 3 percent of the investment made by such businesses. Capital expenditures in facilities used to process cold-rolled sheet and to process wire rod, wire, and wire products each accounted for between 15 and 20 percent of capital expenditures.

Pollution Expenditures

During 1989, the U.S. steel industry invested $172 million in pollution control, which accounted for 0.3 percent of total net sales. The relative burden of pollution expenditures did not vary significantly among the four steelmaking sectors. Pollution expenditures represented 0.3 percent of integrated producers' total net sales

[53] "The Attractions of Direct Current," *MBM Supplement*, October 1989, p. 11.
[54] George J. McManus, "Electric Furnaces Turn Up the Power," *Iron Age*, November 1988, pp. 14-23.

0.2 percent of specialty producers' total net sales, 0.3 percent of minimill producers' total net sales, and 0.08 percent of converters' total net sales. Integrated producers accounted for 73 percent of total pollution expenditures; minimills, 19 percent; specialty mills, 5 percent; and converters, 3 percent. Data were not collected on a product line basis, but information from other sources indicate that the majority of pollution control expenditures in 1989 were made on the "hot end" processes (i.e., cokemaking, blast furnaces, and raw steelmaking).

Changes In Ownership and Corporate Structure

During 1989, a number of steelmaking facilities changed hands as companies attempted to enhance their competitive positions in principal markets. In some instances, facilities were sold to new owners as U.S. steelmakers divested operations not directly related to their principal markets, or as foreign steelmakers endeavored to expand operations in the United States. In other instances, domestic firms and foreign competitors formed joint ventures as a means of enhancing the competitiveness of both.

Acquisitions and Sales of Existing Facilities

Integrated Steelmakers

During December 1989, Ford Motor Co. sold 80 percent of its interest in Rouge Steel to Marico Acquisition Corp. Ford had been negotiating to sell Rouge since 1983 in order to sharpen its focus on the auto market.[55] The sale will reportedly result in a modest diversification of Rouge's sales toward the appliance and office furniture markets, although the automotive industry will remain the company's principal market. Ford is reportedly obligated to purchase 40 percent of its North American steel needs from Rouge during the next 10 years.[56]

Elsewhere, LTV Steel sold its bar division to Republic Engineered Steels, Inc., an employee stock ownership plan (ESOP), for an estimated $220 million. The new company, headquartered in Massilon, OH, consists of nine plants located in Ohio, Pennsylvania, Indiana, Illinois, and Connecticut. With over 5,000 employee-members, Republic has over $800 million in annual sales and is the largest domestic producer of special quality bars. The divestiture of Republic will reportedly allow LTV, currently in Chapter 11 bankruptcy, to invest available resources in facilities which produce flat-rolled and tubular products. An estimated $400 to $500 million modernization program will apparently be required to modernize Republic's bar facilities to be competitive in the special quality bar (SBQ) market.[57] The magnitude of investment required to remain in the SBQ market has recently motivated other major mills, such as the United States Steel Division of USX Corp. (USS), Inland, and Bethlehem, to reassess or restructure their bar operations.

Not unlike LTV's divestiture of its bar division was Armco's June 1989 divestiture of its structural mill, located in Houston, TX. Armco closed the mill during 1983, when steel demand declined, and began negotiating to sell the facility to Northwestern Steel and Wire (Sterling, IL) during 1987. The sale of the facility was, in part, motivated by the minimills' impending penetration of the market for medium and heavy structurals.[58] Northwestern, Nucor-Yamato, and Chaparral's entrance to the medium and heavy structurals market has since motivated other major mills like Inland and Bethlehem to carefully consider their continued participation in the market.[59]

Divestitures of certain nonsteel-related assets were completed during 1989 as well. Such divestitures included Armco's sale of its Reserve Mining assets, located in Minnesota, and Bethlehem's sale of its shipyard located in Beaumont, TX.

Minimills

A number of minimill facilities also changed hands during 1989. In January 1989, Georgetown Industries (Charlotte, NC) announced its $120 million purchase of Tree Island Industries (Vancouver, BC). Georgetown Industries is the parent company of Georgetown Steel (Georgetown, SC), a wire rod producer, and Tree Island Industries is a major West Coast supplier of nails, steel wire, and fabricated wire products, with operations in Vancouver, San Francisco, CA, and Los Angeles, CA.[60]

In March 1989, Daido Steel Co. (Japan) purchased 17 percent of Copperweld Steel Co. (Warren, OH) from Imetal (France), which owned 50 percent of the company. Daido and Copperweld had been technological partners for

[55] Form 8 K, Ford Motor Co., Feb 15, 1990.
[56] For a more complete discussion of this issue, please refer to Rouge's company profile in appendix G.
[57] "Employees Buy LTV Bar Division," *Metal Bulletin*, Dec. 8, 1989, p. 26.
[58] Andrew Collier, "NW Steel to Buy, Expand Armco Wide-Flange Mill," *American Metal Market*, Mar. 17, 1987, p. 1.
[59] "Minis Put Squeeze on Majors in Structurals," *Metal Bulletin*, July 3, 1989, p. 26; Tom Balcerek, "Bethlehem Eyes Fix in Structurals," *American Metal Market*, March 20, 1990, p. 1; and Tom Balcerek, "Bethlehem Faces Difficult Choices on Product Lines," *American Metal Market*, May 16, 1990, p. 1.
[60] Tom Balcerek and Frank Haflich, "Georgetown Plans to Buy Tree Island," *American Metal Market*, Jan. 18, 1989, p. 1.

more than two decades and joint venture partners since 1988, when the two formed Ohio Star Forge Co., which produces forgings for the automotive industry. Daido's acquisition will reportedly facilitate the implementation of a $20 million modernization program, which will support efforts to manufacture bar with increasingly tight specifications.[61]

Yamato-Kogyo and the Sumitomo group (Japan) acquired Razorback Steel Corporation (Newport, AK) for $20 million during August 1989. Yamato's acquisition of Razorback, which produces billets and railroad tie plates, was reportedly motivated by the desire to retain market share in the United States. Continuation of the VRAs and the high value of the yen have reportedly contributed to a decline of U.S. imports of Yamato's tie plates by approximately 90 percent, from about 100,000 tons in 1983 to 11,000 tons in 1989. Yamato reportedly derives 15 percent of its total revenues from sales of rail products.[62] [63]

In addition, Oregon Steel Mills (Portland, OR) purchased California Steel Industries' idle 148-inch plate mill at Fontana, CA, during November 1989. The acquisition gave Oregon the ability to make pipe skelp wide enough for its Napa Pipe Corp. subsidiary to produce 42-inch pipe.[64] Napa Pipe is reportedly one of the United States' three pipe mills which is capable of producing such pipe.[65]

Specialty Steel Producers

During August 1989, Sammi Group, parent company of Sammi Steel Co. (Korea), purchased Al Tech Specialty Steel Corp. (Dunkirk, NY) and two Canadian specialty mills from their former parent, Rio Algom (Toronto, Ontario), for $211 million. Al Tech is one of the three largest stainless steel bar producers in the United States, and also produces tool steel and stainless steel pipe and tube. Sammi indicated that the acquisition complemented its existing businesses and enhanced Sammi's position as one of the world's largest specialty steel producers.

More recently, Ugine Aciers, a subsidiary of Usinor-Sacilor (France), initiated the acquisition of J&L Specialty, the United States' second-largest stainless steel producer, during March 1990.[66] Usinor-Sacilor's $570 million acquisition[67] of J&L is part of the French company's effort to establish an enduring presence in the U.S. market, where some of its traditional clients have also established operations, and gives Usinor-Sacilor over 20 percent of the United States' stainless flat-rolled market.[68] [69]

Formation of Joint Ventures

Since January 1989, eight steelmaking joint ventures involving six U.S. companies and seven foreign companies have been announced. U.S. steelmakers appeared to enter such ventures because foreign companies offered the technology and capital necessary to enhance U.S. steelmaking operations in high value markets, such as those for coated flat-rolled products and special quality bar. Foreign firms, in general, found joint ventures an attractive means to supply traditional clients who have facilities located in the United States, such as the Japanese auto producers. Other factors which may have motivated foreign producers' participation in the U.S. steel industry were exchange rate movements, which have made investment in the United States relatively inexpensive, and the existence of trade measures, such as the VRAs, which have affected the terms under which steel could be imported into the U.S. market for many years.

Most joint ventures involve only particular operations within a plant, or particular plants operated by a company. In five cases (those of the Armco-Acerinox cold-rolling mill, I/N Kote, L/S II Electrogalvanizing Co., the LTV/Steel Tech/Mitsui cutting and slitting venture, and USS/Kobe's galvanizing venture), entirely new facilities costing between $150 and $450 million each are being constructed. Joint venture partners that conduct their business in preexisting facilities, on the other hand, have generally undertaken new or accelerated modernization programs. Table 21 details the U.S. and foreign steelmakers who have announced the formation of joint ventures since January 1989.

Armco, Inc., and Kawasaki Steel Corp. (Japan) created Armco Steel Co., L.P., during May 1989 to own and operate Armco's former Eastern Steel Division, which includes the facilities at Middletown, OH, and Ashland, KY. These facilities account for approximately 70 percent of Armco Inc.'s total steel production. Kawasaki acquired a 40 percent interest in the venture with an initial $350 million payment and will reportedly increase its interest to 50 percent over the next 2 years for an additional $175 million. Armco Inc. has indicated that formation of the joint venture provides it with greater financial

[61] "Daido Buys 17% Stake in Copperweld," *Metal Bulletin*, March 16, 1989, p. 23.
[62] "Japanese Buy US Mini," *Metal Bulletin*, Aug. 14, 1989, p. 21.
[63] Tom Balcerek, "Japanese Group to Buy Razorback," *American Metal Market*, Aug. 11, 1989, p. 1.
[64] Frank Haflich, "Oregon Steel Buys Idle CSI Plate Mill," *American Metal Market*, Aug. 18, 1989, p. 1.
[65] Frank Haflich, "Oregon Steel Closes Carbon Plate Mill Buy," *American Metal Market*, Nov. 21, 1989, p. 1.
[66] "Usinor Makes Two New Moves Into US Steel," *Metal Bulletin*, Mar. 29, 1990, p. 31.
[67] Stewart Toy et al., "France is Quietly Forging a Steel Empire," *Business Week*, Apr. 30, 1990, p. 90.
[68] Peter Scolieri, "France's Usinor-Sacilor in Quiet US Buying Binge Over Past Two Quarters," *American Metal Market*, March 19, 1990, p. 1.
[69] For further discussion of this topic, see *Monthly Report on the Status of the Steel Industry*, USITC Publication 2226, June 1990, pp. i-iii.

ɔle 21

ɜel: Joint ventures formed since January 1989

ɔmestic ɔmpany	Foreign Company	Foreign Interest	Facility specialization
		(percent)	
nco	Kawasaki	50	Flat-rolled products
nco	Acerinox	50	Stainless steel strip
ɔrgetown	Usinor-Sacilor	50	Carbon and alloy wire rod
nd	Nippon	50	Galvanizing lines
/	Sumitomo	50	Galvanizing lines
/. Steel Tech	Mitsui	33	Cutting and slitting lines
S	Kobe	50	Special quality bar
S	Kobe	50	Galvanizing lines

ɪrce: Articles from American Metal Market and Metal Bulletin, various issues.

ɜngth. Kawasaki's capital injection, for inɴce, will apparently allow Armco Steel Co. to ɜelerate a previously announced $1.1 billion dernization program.[70]

In addition, Armco Advanced Metals Corp. ɨ Acerinox SA (Spain) are planning the conɪction of a stainless steel cold-rolling mill. The ɴ $150 million facility, with a capacity of ɜ,000 tons per year, is scheduled to begin opɵions during 1992. The venture's partners will us on the domestic and European markets for inch-wide strip; only one other U.S. producer ɔcesses stainless steel strip as wide as 60 hes.[71] [72]

Inland Steel and Nippon Steel Corp. (Japan) ɔned a second joint venture, to follow I/N Tek, ir continuous cold-rolling mill, during Septem- 1989. The new 50-50 joint venture, I/N ɜe, will comprise one 500,000 ton-per-year hot galvanizing line and one 400,000 ton-per-year ɔtrogalvanizing line, both of which will be able ɨpply zinc and zinc alloy coatings that are inɑsingly being demanded by the automotive ustry. Located adjacent to I/N Tek in New lisle, IN, I/N Kote will allow Inland and Nip- to supply domestic clients with high-quality ted sheet and strip and, in addition, will inɑse I/N Tek's effective capacity by about 50 ɔent.[73]

During March 1990, Usinor-Sacilor's subsidi- Unimetal (France), agreed in principle to form a 50-50 joint venture with Georgetown Steel Corp., a producer of reinforcing bar and carbon and alloy wire rod located in Georgetown, SC. The technology and capital provided by Usinor-Sacilor will support Georgetown's move into the high end of the carbon and alloy rod market, where the company has not competed to any great extent in the past. As a result of the joint venture, Usinor-Sacilor will also be able to supply the U.S. operations of its traditional clients, Michelin and Bekaert, with high quality wire used in tire cord.[74] [75]

LTV Steel and Sumitomo Metal Industries (Japan) announced the formation of their second joint venture, L/S II Electrogalvanizing Co., during May 1989. The business, located in Columbus, OH, will be able to apply zinc, zinc-nickel, and zinc-nickel and organic coatings to 360,000 tons of flat-rolled product per year. The 50-50 joint venture is designed to increase the ability of both partners to supply galvanized steel to domestic auto manufacturers.[76] In addition, LTV agreed during May 1990 to construct and operate two joint ventures with Steel Tech (Louisville, KY) and Mitsui Steel of Japan. These facilities, which are expected to begin operations by the end of 1991, will cut, slit, and warehouse sheet products in order to provide better service to LTV's customers, especially automakers.[77]

USS and Kobe Steel (Japan) have formed two joint ventures since January 1989. In July 1989, the two companies formed USS/Kobe Steel Co. to own and operate USS's former Lorain, OH, works, which reportedly requires an estimated

"Kawasaki Steel Buys into Armco Plant," *Steel ɜs International*, May 1989.

Peter Scolieri, "Armco, Acerinox Target Wide ɪless," American Metal Market, Nov. 27, 1989,

In addition, Armco entered into two marketing joint ɪres during 1989; one with Acerinox to process and ɜet flat-rolled chrome stainless steels for European ɴotive exhaust systems, and the other with Delloye hieu (a unit of Cockerill Sambre Steel Co. in um) to market grinding steel media and related ral processing products to European, African, and ile Eastern cement producers.

"Adjusting as Preeminence Slips," *The Washington* Dec. 11, 1989, p. A-18.

[74] Tom Balcerek, "Usinor has French Word for its US spree: niche," *American Metal Market*, May 4, 1990, p. 1.

[75] During 1989, Chavanne-Ketin, a subsidiary of Usinor Sacilor, also set up a steel-related joint venture with Bethlehem Steel. Chavanne-Ketin and Bethlehem will jointly produce rolling cylinders at the BethForge Division, located near Bethlehem, PA.

[76] Labee and Samways, p. D-5.

[77] Tom Balcerek, "LTV, Steel Tech, Mitsui Plan Midwest Venture," *American Metal Market*, May 17, 1990, p. 1.

$300 to $400 million investment to be internationally competitive. The 50-50 partnership will enhance the ability of both partners to supply SBQ steel to domestic auto manufacturers. Formation of the joint venture was reportedly prompted by a request from Toyota Motor Corp., Honda of America Manufacturing Inc., and Nissan Motor Manufacturing Corp. U.S.A.[78]

In addition, USS and Kobe formed Aztec Coating in early 1990 to construct and operate a 600,000 ton-per-year hot dip galvanizing facility. It is reported that the facility, located in Leipsic, OH, will principally supply galvanized product to domestic auto manufacturers beginning in 1992. Formation of the partnership provided USS with a long-term cash infusion of $250 million while increasing Kobe's ability to supply Japanese automakers' U.S.-facilities.[79]

The formation of other joint ventures appears likely in the future as U.S. steelmakers pursue both advanced technology and foreign capital. It has been reported that National Steel, Nippon Kokan K.K. Corp. (Japan), and Dofasco (Canada), for instance, are studying the feasibility of a jointly owned, 400,000 ton-per-year hot dip galvanizing facility.

Research and Development Activities

Introduction

Reflecting the financial problems of the steel industry during of the 1980s, much of the U.S. steel industry's research and development (R&D) efforts were shifted into cooperative efforts involving industry, the Federal Government, and universities and colleges. Industry's direct role in basic research[80] is relatively small. The natio laboratories, universities and colleges perform t bulk of basic research in the United States, t majority of which is funded by the Federal G ernment and is multiclient sponsor Discussions with industry R&D directors indic that university-based research is very cost eff tive in contrast to that done in the natio laboratories, which were characterized as hav very good people and equipment, but consider to be very expensive. Industry, however, p forms the bulk of applied research,[81] which being done increasingly on a collaborative basis help defray cost.

Research and Development Expenditures

R&D expenditures in steel totaled $173.4 n lion in 1989, which was equal to 0.3 percent total net sales (table 22). Comparing 1989 resu with prior periods (adjusted to reflect similar porting samples) indicates that total expenditu in 1989 were about 18-percent higher than t average expenditures by reporting companies d ing the last 2 years, 1987–88 and 1988–89 Research and development expenditures by pr ess and product are detailed in appendix D, ta D-17.

[78] Tom Balcerek, "USS/Kobe Aim: Record of Earnings," *American Metal Market*.
[79] "USS/Kobe Goes Ahead with New Galv Line," *Metal Bulletin*, May 7, 1990, p. 25.

[80] Basic research involves original investigations for the advancement of scientific knowledge not having specific immediate commercial objectives, although th may be potential interest to the sponsoring company o institution.
[81] Applied research is an investigation directed to t discovery of new scientific knowledge having specific commercial objectives with respect to products or proc esses. This is the focus of private sector investment, which is the high-cost, but lower risk, later phase of t innovation "pipeline." This is also the stage where incremental improvements are made to products, ofter generated by customer demands.
[82] Data were collected for the period July 1 to June for each year. See, *Annual Survey Concerning Competitive Conditions in the Steel Industry and Industry Efforts to Adjust and Modernize*, USITC Publication 2226, Oct. 1989.

Table 22

Research and development expenditures of U.S. steel producers, 1989 and Jan.-Mar. 1990

	R&D expenditures			
	Total		*Share of net sales*	
	1989	*Jan.-Mar. 1990*	*1989*	*Jan.-Ma 1990*
	Million dollars		*Percent*	
Carbon and certain alloy steel[2] ...	129.5	32.0	0.3	0.3
Stainless and tool steel	43.9	5.6	0.9	0.5
Total certain carbon and alloy steel	173.4	37.6	0.3	0.3

[1] Total net sales includes intracompany and intercompany transfers, less discounts, returns, and allowances.
[2] Certain alloy refers to alloy steel other than stainless and alloy tool steel.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commissio

A comparison of R&D expenditures by segıent indicates that the integrated producers and ıe specialty steel producers accounted for about 6 percent and 32 percent, respectively, of total &D expenditures. Spending by minimills and rocessors, which was roughly equal on a percentge basis, accounted for the balance. On a roduct line basis, integrated producers acounted for approximately 75 percent of R&D xpenditures on carbon and certain alloy steels ith another 10 percent being accounted for by ıe specialty and alloy tool producer segment. tainless and alloy tool producers accounted for out 99 percent of R&D expenditures on such eels.

Comparing company spending on R&D in re.tion to total net sales indicates that specialty eel producers outspent the other three groups ntegrated, minimills, and processors). R&D exenditures as a percentage of total net sales were .2 percent for the specialty steel sector, 0.3 perent for the integrated sector, and 0.1 percent ach for minimills and processors during 1989. he ratio appears lower than that in most other ıdustries in the United States, where expendiıres ranged from 0.6 percent of net sales in the ıdustry producing lumber, wood products, and ırniture to 12.6 percent of net sales in the indus-y producing office, computing, and accounting ıachines in 1987.[83]

Company research and development efforts re concentrated in the "hot end" (cokemaking, onmaking, raw steel production and semiished products) and the development of nproved flat-rolling operations and products. umerous programs being undertaken by the ompanies, either by themselves or as part of colıborative efforts, aim toward the replacement of oke ovens and the eventual elimination of the onventional blast furnace and oxygen furnace. esearch and development expenditures on sheet nd strip account for 50 percent, and those on nproving "hot end" products and processes acounted for about 21 percent of total R&D xpenditures for carbon and alloy steel. Spendıg by minimills and processors was concentrated n improving electric furnace operations, and ire drawing and welded-pipe making, respecvely.

Cooperative Research in the Steel Industry

The domestic steel industry, especially in the rograms coordinated by the American Iron and teel Insitute, is aiming its collaborative research t various parts of a visionary "steel plant of the future." The goal is a plant that can process raw materials into finished product, such as cold rolled sheet, in a 10- to 12-hour period (as compared with approximately 12 to 15 days today), with energy savings of up to 25 percent, when compared to current methods. Keys to achieving this type of plant are direct steelmaking, near net shape casting, and intelligent processing involving sophisticated sensors and process control systems. Much of the collaborative R&D efforts are funded by industry[84] and the Federal government under various programs. Selected programs are described below.

Department Of Energy Sponsored Programs[85]

The U.S. Department of Energy (DOE) has the authority and program funding to assist the steel industry in conserving energy and for the development of competitive technology programs.[86] DOE currently has three major programs underway: superplastic steel processing, spray forming of steel, and direct steelmaking.[87] Legislation is reportedly in process that would extend DOE's authority to fund R&D in casting, perhaps under the Energy Conservation and Technology Competitiveness Act.[88]

Superplastic steel[89] processing was funded beginning in March 1988, and phase I is scheduled for completion during the Federal Government's

[83] See, National Science Foundation, Research and evelopment in Industry: 1987, NSF 89-323, p. 45, for ı industry-by-industry comparison of R&D expenditures ; a percentage of net sales.

[84] The National Cooperative Research Act of 1984 authorizes cooperative R&D by competing companies in an industry through the stage of prototype testing, but does not change the application of the antitrust laws with respect to production, marketing, or the sale of products.

[85] A program to improve the competitiveness of U.S. industry in general and the steel industry in particular has evolved during the 1980s. The 1983 "Packard Report" recommended increasing collaboration between universities, the national laboratories, and industry. The 1984 "Keyworth Report" recommended the development of a cost-shared program to include the Federal Government and the steel industry using the DOE's national laboratories to develop leapfrog technology in steelmaking. Beginning in 1985, DOE was directed to implement a research and development initiative with the national laboratories to achieve advanced ("leapfrog"), energy efficient steel process technologies contingent on industry sharing the cost. Priority is given to certain areas of steelmaking and processing, and the knowledge gained is only available to the participating companies and researchers.

[86] See, Public Law 100-680, The Steel and Aluminum Energy Conservation and Technology Competitiveness Act of 1988.

[87] U.S. Department of Energy, "Steel and Aluminum Energy Conservation and Technology Competitiveness Act of 1988: Research Plan (May 1989), Management Plan (May 1989), Annual Report (Feb. 1990)."

[88] Marilyn Werber, "Casting Bills to Map R&D," *American Metal Market*, Apr. 23, 1990, p. 9A.

[89] Superplastic behavior implies superior forming characteristics and would lead to greatly reduced machining costs and scrap generation in manufacturing processes. Superplastic steels would also exhibit unusually high tensile elongations, exceptional strength, and ductility, and wear resistance. Research efforts concentrate on ultra-high carbon steels with aluminum additions. Such steels would reduce the need for extensive heat treatment operations for many operations.

fiscal year (FY) ending September 30, 1990. The project is managed by Lawrence Livermore National Laboratory with research involvement by Stanford University, and is being cost-shared by three companies: North Star Steel Co. (the only steel producer involved), Ladish Corp., and Caterpillar Inc. DOE funding obligations for phase I total about $1.5 million, and funding by industry totals about $465,000. Phase II obligated funding from DOE is projected at $825,000 in FY 1990, and $1.8 million in FY 1991.

The overall objective is to develop a steel composition and processing sequence on a commercial scale to produce superplastic steels and to test their die-filling and forging capability. According to DOE, a successful cast was made using a small, pilot-scale, continuous casting machine, and the die-filling capability of the ultrahigh carbon steel has been demonstrated by press forming. Phase II will include the efforts to optimize the ultrahigh carbon steel composition in order to maximize production, processing, and fabrication efficiencies.

A project for spray forming of steel was funded beginning in March 1989. This is a process in which liquid steel is converted into a spray of droplets, which are then partially cooled in flight and compacted against a substrate to form a near-net shape solid, such as a thin sheet or strip. The project is managed by the Idaho National Engineering Laboratory (INEL). Initial industrial participants include Air Products, Ajax Magnethermics, A.O. Smith, Chaparral Steel, Chrysler, Ford Motor Co., Geneva Steel, and Haynes International.[90] DOE funding totaled $1.45 million with the industrial participants spending almost $778,000 during FY 1989. Phase I is projected to cost $5.7 million, of which $3 million is to be obligated in FY 1990, and $1.2 million is to be obligated in FY 1991.

The overall objective is to develop a near-net shape spray forming process for the continuous production of low-carbon steel sheet and strip products. Energy savings would be achieved through the elimination of slab casting machines, reheat furnaces, and hot strip rolling mills, as spray forming would produce a near-net shape product.[91]

A third research program is the direct steelmaking project. The primary objective of the project is to develop a leapfrog technology for in-bath smelting and refining. Such a technology would go beyond direct ironmaking and eliminate or modify current batch steelmaking processes in basic oxygen furnaces. In other words, it would replace the blast furnace, coke oven and oxygen steelmaking process, and convert iron ore to liquid steel in a single reactor system utilizing coal and iron ore pellets. Direct steelmaking holds the promise of being an energy efficient, economically competitive process that will effectively use domestic raw materials, eliminate coke ovens and their associated environ- mental problems, provide further impetus to technological change in steelmaking, and reduce the minimum economic scale of steelmaking from iron ore.

The project involves the construction of a pilot-scale continuous smelting and refining unit at Universal, PA. In addition, the project is being supported by studies at Carnegie Mellon University and the Massachusetts Institute of Technology (MIT), as well as heat transfer work being done at Dofasco Steel Co. of Canada. The results of the laboratory research programs and heat transfer studies will be incorporated with the information gathered in the pilot plant.

The project is being carried out under a cost-sharing cooperative agreement between the member companies of the AISI and the DOE. DOE expenditures during FY 1989 totaled $4.9 million, while the value of AISI's contribution was about $1.5 million. The project is expected to cost approximately $30 million over a 3-year period, with DOE providing approximately 77 percent ($23 million) of the funds, and AISI the remainder.[92] The research plan currently calls for $9.3 million to be obligated by DOE during FY 1990, $6 million during FY 1991, and $435,000 during FY 1992. Several participants indicated that, although the project is scheduled to last only three years (and may lead to a demonstration commercial scale plant), the technology may take 10 to 15 years to be commercialized.

National Institute of Standards and Technology Sponsored Research

The Steel and Aluminum Energy Conservation and Technology Competitiveness Act of 1988 authorizes DOE and National Institute of Standards and Technology (NIST) to carry out coordinated programs in support of primary metals industries. DOE's focus is described above; NIST concentrates on providing instrumentation and measurement. The general term, "intelligent processing," includes the identification of important properties for measurement, the development of sensors to measure those properties, and the development of control theories and algorithms to regulate production processes.[93] Three areas are currently being studied. One involves

[90] Only Chaparral and Geneva are steel producers.
[91] The program is divided into two phases in which the technology development moves from bench-scale (Phase I) to pilot plant scale (Phase II). Phase I is scheduled to take two years, and is based on nozzle systems being concurrently developed at the INEL, MIT, and the Oak Ridge National Laboratory.

[92] AISI, "Direct Steelmaking," 1989 Brochure.
[93] National Institute of Standards and Technology, "Intelligent Processing for Primary Metals," NIST Special Publication 772: Report of Workshop, Aug. 29-30, 1989. Nov. 1989.

he development of new sensors and sensor technology, including advanced and "robust" sensors which might provide on-line quality assurance and continuous temperature, chemistry, and physical measurements. A second area is the development of process control and in-detail process models. The third area being studied is the development of advanced control theory, which includes artificial intelligence techniques in certain well-defined circumstances, such as operator guidance systems, communications, estimation techniques, and numerical data bases. As a new generation of processes for steelmaking develop, modern techniques for intelligent processing are expected to play a greater role.

National Science Foundation University/Industry Cooperative Research

The National Science Foundation (NSF) established the University/Industry Cooperative Research Centers in 1973 to stimulate industrial support for university research by identifying areas of mutual interest that are amenable to long-term collaboration. The centers are not dependent on government funding. The research foci are determined by the universities in consultation with corporate entities. Research results are proprietary to the sponsors for a certain period of time. Of the 40 centers which perform basic research, two are involved in steel: the Colorado School of Mines (steel rolling and shaping) and Carnegie-Mellon University (primary steelmaking).

The Advanced Steel Processing and Products Research Center was established at the Colorado School of Mines in October 1984. A total of $575,000 was provided by the NSF until 1989;[94] it is currently funded almost entirely by industry sponsorships.[95] The center's research is focused on the evaluation of new steel products and steel applications in manufacturing. The center conducts four major research programs on sheet steels, plate steels, bar and forging steels, and special alloys and stainless steels.

The programs at Carnegie Mellon are structured in much the same way and there is some overlap with programs at the Colorado School of Mines; the distinction between programs lies more in the fact that the programs at Carnegie Mellon are focused on long-term and basic research in steelmaking processes, while those at the School of Mines are more product oriented.

[94] Colorado School of Mines, "Advanced Steel Processing and Products Research Center," Annual Report, March 1990.

[95] Each of the 19 corporate sponsors contributes $37,500 annually; the school contributes equipment, facilities and faculty.

American Iron and Steel Institute-Northwestern University Collaboration

The American Iron and Steel Institute (AISI) also has invested in the development and application of automated processing technology, including the application of artificial intelligence to, and the development of expert systems for, process control, inventory control, production scheduling, and customer service. AISI-sponsored research is underway at the Northwestern University Steel Resource Center[96] on strategic planning of manufacturing operations and on an expert system for slab disposition from a continuous caster. Other technical topics that have been discussed at the center are sensor technology and instrumentation for process control, process modeling, artificial intelligence, innovative near net shape casting techniques, steel surfaces and interactions, and environmental issues.[97]

Intra- and Interindustry Collaboration

AISI-member companies have collaborated with raw materials and equipment suppliers, as well as government agencies and universities on a number of research projects. The projects include research on refractories; measurement of temperature distribution within, and analysis of, hot steel; dimensional measurements of seamless pipe; and the development of computer-based decision support systems. Resources committed in 1989 totaled $7.4 million, $3.2 million of which was sourced from AISI-member companies.[98]

In addition to AISI programs, there are a number of other programs involving collaborative efforts. Some involve near-net shape casting of mill products. The aim of casting steel closer to the final shape is to reduce energy and capital costs. An additional advantage is that the product's microstructure may be superior due to more rapid solidification than is possible in traditional casting methods. Related research includes thin slab casting, spray casting, and strip casting. Thin slab casting research has slowed with the installation of a commercial unit, based on European technology, in Crawfordsville, IN, by Nucor Corp. Thin slab casting generally involves casting sections 1-2 inches thick. Development work continues at the site and the technology is reportedly not yet performing up to expected design parameters.

[96] The American Iron and Steel Institute in partnership with Northwestern University established the Steel Resource Center at Northwestern in Jan. 1987.

[97] AISI, Summary Report: Forum to Identify Long-Range Research Opportunities for the North American Steel Industry, Jan. 18-19, 1989.

[98] Memorandum from W.E. Dennis, Vice President for Manufacturing and Technology, AISI, to M. Deaner, President, AISI, Dec. 7, 1989.

Several companies have programs underway, either singly or in groups, focused on strip casting, which involves casting narrow (4 to 22 inches) steel coils in thicknesses ranging from 0.04 to 0.2 inches. The participants in the five current programs are (1) LTV Corporation; (2) Armco-West; (3) Bethlehem, Inland, Weirton, and Armco; (4) National Steel-Battelle Memorial Institute; and (5) Allegheny Ludlum. Allegheny Ludlum and Voest Alpine Industrieanlagenbau (an Austrian-based steelmaker and equipment manufacturer) recently announced a joint decision to design, engineer, and build a commercial-size prototype thin strip direct casting machine to produce stainless and carbon steel flat products; this follows an 18-month period of evaluation.[99] The new technology to direct-cast sheet and strip steels would eliminate the need for conventional slab or ingot casting and the current hot strip rolling practices, resulting in significant cost savings on energy and increased efficiency.

In addition to the research programs under DOE sponsorship discussed above, there is industry research on spray casting technology which involves spraying molten metal onto refractory preforms. The most common mill products for spray casting are pipe and sheet. Most spray casting research is taking place in West Germany and the United Kingdom, although Nucor reportedly is engaged in a spray casting project.

U.S. research and development work in corrosion resistant steels emphasizes coated products, although some work on lower cost stainless grades and weathering steels[100] is proceeding. Although corrosion resistant coated steels have existed for a long time, current research involves new alloy coatings and layered (metallic/organic) coatings. Most of this work is being driven by the demands of the industry's automotive customers.

Eleven cooperative research projects on galvanizing sponsored by the International Lead-Zinc Research Organization affect steel directly.[101] These are focusing on the development of specific corrosion data for zinc-coated steel that enable galvanized steel to be more competitive with stainless steel, aluminum, or other types of coated steel.

[99] Allegheny Ludlum Corp., "Thin Strip Steel Caster to be Built," news release, June 20, 1990.

[100] Weathering steel is designed to develop a thin coating of rust on the surface, which then serves to protect the steel from further oxidation. Weathering steels are not a new development, but older versions have not performed up to expectations, leading to ongoing research and improvement.

[101] J.F. Cole and F.E. Goodwin, "Widening the Use of Galvanizing Through Research," *American Metal Market*, May 2, 1990, p. 10.

Actions to Improve Product Quality and Customer Service

Background on Quality

In response to consumer demand for higher quality products[102] as well as intense global competition, U.S. steel producers have initiated new strategies to improve their performance; efforts have included extensive capital investment in new machinery and equipment, and the implementation of statistical process control (SPC) systems and process analysis techniques.[103] Efforts to improve product quality extend from the design stage of product development (based on close monitoring of customer needs) through the manufacture and shipment of final products in a timely manner.

The term quality has no specific definition and is often subjectively characterized. It may be broadly defined as the combination of attributes (or characteristics) that (a) make a product fit for further processing, and (b) ensure the final part performs in operation. The level of acceptable product quality varies among end users and is typically determined on the basis of product end use. For example, customers producing automobiles have higher specification requirements regarding the appearance (surface quality), and the metallurgical and dimensional aspects of the steel sheet that they use. In contrast, consumers of steel that is used to construct buildings and bridges tend not to have stringent requirements for the steel's cosmetic appearance, but do demand exacting metallurgical specifications to ensure that the final steel product meets established performance standards. Quality standards may also vary within product categories. For example, certain customers require rust-free structural steels whereas others do not.[104]

Quality is an issue of growing importance to most firms in the steel industry, and its related consuming industries. Many global steel producers have pursued this objective to the point of achieving a significant competitive advantage over other domestic and foreign producers. Consequently, the concept of quality, while varying among end users, also connotes a basic requirement that has become a growing prerequisite for initiating further improvements in competitive position. Continuous quality improvement

[102] Examples of more demanding standards required by steel purchasers, as reported in their responses to the Commission's questionnaire, include improvements in surface quality, gauge control, chemical composition, and mechanical properties.

[103] More detailed information on U.S. producers' capital investments is presented in the section entitled "U.S. Producers' Capital Expenditures".

[104] Information developed through discussions with service center industry officials in December 1989.

become essential to steel producers' efforts to effectively supply their end-user customers for whom defects in steel raw materials can lead to costly disruption of manufacturing operations.

As noted above, the issue of steel quality encompasses certain fundamental elements and characteristics that vary in importance, depending on the type of product and its associated end use. Discussions with representatives from various industries yielded a range of attributes that contribute significantly to steel product quality.[105] These characteristics fall into six major categories: internal quality;[106] dimensional quality;[107] surface quality;[108] properties;[109] presentation;[110] and, coating quality.[111] These six quality elements form the basis for an assessment by steel producers and purchasers evaluating the domestic and foreign industry's product quality performance. Results of this assessment, compiled on the basis of information submitted in response to Commission questionnaires, are presented later in this section.

Product quality can be evaluated by certain quantitative measures such as rejection rates. Although discussions with industry officials have indicated that such statistics are maintained by some end users on an individual product basis, many companies do not collect any kind of quantitative data measuring the quality of their products.[112] Furthermore, there exists no standardized, industry-wide quantitative analysis of steel product quality. Under certain market conditions, quantitative data such as rejection rates may not accurately reflect the level of product quality; consumers are likely to reject more material in a slack steel market than in a tight one. Consequently, product quality has to be assessed, for the most part, subjectively on the basis of consumers' perceptions of producers' abilities to meet the major quality requirements.

Quantitative work has been done in certain areas, however. A Task Force on Uniformity of Materials Properties (TFUMP) was formed as part of the Auto/Steel Partnership Program (ASPP); the ASPP consists of representatives from the three major North American auto producers and ten North American steel producer members of the AISI.[113] The ASPP focuses efforts on joint problem solving in areas such as steel quality, stamping efficiency, on-time delivery, material utilization and corrosion resistance. The effort encompasses all aspects of the supplier/consumer relationship and targets improved competitiveness for both the steel and automotive industries in the United States. These teams of steel engineers and technical service personnel work with auto companies to develop steel that meets the needs of designers; help production engineers modify existing metal-forming operations; and help develop and test new tooling.[114]

The task force collected data as part of a program to evaluate the uniformity of properties of two grades of sheet steel (electro-galvanized and cold-rolled), which together comprise about one-third of the steel sheet consumed by the domestic automobile industry. The data were gathered and evaluated for steel produced by two Japanese producers, one German producer, and several North American producers. Details on the results of this analysis are presented in the section of this discussion under, "Current Status of U.S. Industry."

Background on Customer Service

In addition to product quality, the development of a close working relationship with customers is essential to steel producers' efforts to supply steel on a more competitive and timely basis. Customer service also encompasses a wide range of elements that vary in importance according to individual customers' needs. It is broadly defined as delivery to the customer of the product and service as promised and includes such characteristics as reliability of delivery, pre- and postsale technical assistance, responsiveness to complaints, extension of credit, and availability of just-in-time delivery.[115]

Increased demand from customers for better service and quality (in particular, more responsive and efficient order processing and delivery on tight schedules) have led steel producers to focus more closely on customer needs at the initial stage of new projects, often by providing technical and engineering support.[116] For example, LTV has formed a Customer Technical Center, which coordinates meetings that LTV engineers hold at their customers' plants to discuss these customers' steel requirements and to advise them on the

[106] Discussions occurred with officials of certain integrated steel companies, the steel construction industry, the cold-finished steel bar industry, and various company-members of the Steel Service Center Institute.
[107] Includes chemistry, microstructure, grain size, inclusions.
[108] Includes shape, size, length, straightness.
[109] Includes seams, smoothness, shearing.
[110] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[111] Includes packaging and marking.
[112] Includes types of coatings, thickness (including uniformity) and weight.
[113] Information developed through discussions with officials of various steel-producing and steel-consuming companies in December 1989.
[114] The members of the ASPP are the American Iron & Steel Institute, Armco Inc., Bethlehem Steel Corp., Chrysler Motors Corp., Dofasco Inc., Ford Motor Co., General Motors Corp., Inland Steel Co., LTV Steel Co., National Steel Corp., Rouge Steel Co., Stelco Inc., USS Division, USX Corp., Weirton Steel Corp.
[115] LTV Corp., news release, May 24, 1989.
[116] Based on discussions with officials of certain integrated steel companies, the steel construction industry, the cold-finished steel bar industry, and various company-members of the Steel Service Center Institute.
[117] The importance of strong customer/supplier relationships in improving competitiveness was also emphasized by Japanese steel industry officials during a meeting with Commission staff on June 21, 1990.

types of steel that best meet their needs. Most major integrated steel producers have adopted similar programs. Closer coordination with customers has also revealed the increasing importance of "just-in-time" manufacturing, a system whereby steel producers supply customers with just enough product to meet current production needs. This method of supply is important for customers that have restructured their operations to meet the needs of their own customers for just-in-time manufacturing.[117]

An important development in customer service is the use of electronic data interchange systems (EDI) to facilitate order processing. Such systems transmit formatted text between computers over phone lines, enabling the electronic automation of sale and post-sale information exchange by transferring business information directly between the customer's and seller's computer systems. Benefits of EDI include immediate response to customer inquiries concerning rolling and shipping schedules, credit information, stock availability, and order status.[118]

Reasons For Quality and Service Improvements

Several forces have acted simultaneously to bring about widespread efforts to improve product quality and service within the domestic steel industry. A primary factor has been increasing worldwide competition within the steel industry and many of its consuming industries. In response, customers, especially those who purchase high value-added products[119], have tightened their specifications on the physical properties of steel, such as strength, formability and hardness, and the tolerances on dimensions such as width and thickness. Consuming industries seek specialized grades of steel tailored to the manufacture of specific parts and products, and demand steel of consistently high quality to maintain high productivity in their operations, which can be adversely affected by defective steel. This growing specialization has spurred a trend away from the mass production of steel having standard chemistries and coatings toward the production of a wide variety of more technically exacting products for individual applications.

The automotive industry has been a leader among steel consumers in tightening the quality standards for more durable and corrosion-resistant steel. For example, in 1985-86, Chrysler launched its High Tech Steel Program, which presented the following targets to steelmakers:[120]

1. Decrease by half the standard variation in metal thickness;
2. Improvements in coating operations including, for example, production of single coating weight of zinc-iron alloy galvanized steel by either hot-dip galvanizing or the electro-galvanizing process (as opposed to the relatively lower-quality zincrometal coating process);
3. Yield-strength variation in high-strength steel reduced by half and eventually by three-quarters;
4. Production of steel sheet that would be thinner, light-weight, and more dent-resistant.

Pressure to improve product quality and customer service has also resulted from Japanese automakers' demands for more sophisticated steel products to supply their manufacturing operations in the United States. According to an official of one Japanese company, demand is growing for products such as resin-sandwiched sheet, aluminized, and zinc-aluminum coated sheet, but there is currently insufficient U.S. capacity to produce such products.[121] A number of the United States-Japanese joint venture operations, including I/N Tek (Inland Steel and Nippon Steel) and Armco Steel Co., L.P. (Armco Inc. and Kawasaki Steel), produce high-value surface-treated sheet for use by the automotive industry. Steelmakers have been successful in their efforts to satisfy automotive producers; automakers' reject rate for steel coils has fallen to less than 1 percent from a decade-high level of 8 percent in 1982.[122]

The growth in installation of vacuum degassers, which increase steel's formability, largely reflects demand for ultralow carbon steel from automotive and appliance manufacturers. In addition, steel users are faced with new needs for safety, environmental protection, and product diversity, which place more demands on steelmakers for steel of lighter weight, greater durability, and higher performance. Competition from substitute materials, such as plastics (e.g., in automobiles) and advanced ceramics, has provided further impetus to steelmakers to produce higher quality steel products.

Vehicles for Achieving Quality and Service Improvements

The growing number of customer/supplier partnerships has resulted in more focused market

[117] "If the Customer Wants It, We'll Do It, Centers Say", *American Metal Market*, Steel Service Center Supplement, May 14, 1990.

[118] "Use of EDI Systems on Rise in Metals Industry", *American Metal Market*, April 13, 1990.

[119] Examples of industries that have raised their standards for steel quality include the automotive and canmaking industries.

[120] "Auto, Steel Teamwork Vital: Chrysler," *American Metal Market*, Feb. 28, 1990.

[121] "Japanese Seek Higher Quality U.S. Steel", *Metal Bulletin*, March 26, 1990.

[122] U.S. International Trade Commission, *U.S. Global Competitiveness: Steel Sheet and Strip Industry*, p. 12 27 (as reported by Ford Motor Co. purchasing department), January 1988; and "Revived Industry Looks Ahead," *33 Metal Producing*, December 1989.

velopment and refinement efforts. According an industry official, marketing efforts, includ- the need for steel producers to work in ance with suppliers, will become increasingly portant over the next decade.[123] The execu- also noted that market development includes research, planning, and investment that pre- les creation of a new product or the plementation of new technologies to satisfy the eds of the customer. These actions are not y steel company activities, but represent a dy- mic partnership between the customer, the elmaker, steel processors and the companies t supply the steel industry with goods and serv- s.[124] Views such as these have led to a revised rketing orientation under which steel compa- s provide a package of value-added products d services that appeal to some consumers, but irrelevant to others.[125]

An example of this approach is the significant ange in market focus exhibited by the inte- ted mills during the 1980s. In the early part of decade, the major producers' marketing ef- ts focused on oil country tubular goods CTG) as automotive demand weakened. By end of the decade, during which there was le activity in the OCTG market, the major steel oducers had shifted their efforts to the high- ue end of the sheet market where the tomotive industry is the prime consumer.[126] e integrated producers continue to improve the ality and properties of their products, in par- ular flat-rolled products, with the major grading of both hot strip and cold reduction lls, the installation of continuous processing es (e.g., combined pickling/cold reduction) d vacuum degassing facilities to produce ralow carbon steels. Major capital investments e also being committed to coating lines.[127]

Other efforts to expand market share include ose by the Tin Mill Product (TMP) Producers mmittee of the AISI, which consists of eight oducers who have pooled their resources in a ncerted effort to acquire a larger share of the od and beverage can market. Through consid- able capital investment and R&D expenditures, e TMP producers have developed new steel can signs (e.g., draw and redraw) and installed the cessary canmaking equipment to produce high- ality cans. The TMP marketing package also cludes producers' promotion of the relative cost ivantage of steel cans over aluminum, and the pansion of steel can recycling.[128]

[123] "Revived Industry Looks Ahead", *33 Metal oducing*, December 1989.
[124] D. H. Hoag, "Market Development: Partnerships tween Suppliers, Customers and Steelmakers", pre- ted at AISI Press Briefing on May 24, 1989.
[125] Robert Spich, "Marketing in the Steel Industry's mpetitiveness Challenge," presentation at the Latin nerican Iron & Steel Congress meeting on Oct. 17, 89.
[126] "Reshuffling Gives Steel Better Edge", *American etal Market*, Dec. 25, 1989.
[127] *Iron & Steel Engineer*, February 1990.
[128] "Tinplate Turnaround", *33 Metal Producing*, cember 1989.

Another catalyst driving the integrated producers' market development efforts is the recent movement by minimill producers into higher value markets. During the 1980s, technology developments have not only reduced costs, but have made it economical for certain innovative minimills to provide products formerly produced economically only in integrated mills. Among those nontraditional products now feasibly produced by minimills are special quality bars, large wide flange beams, and sheet. The minimills' recent entrance into these higher value-added markets will result in their direct competition with domestic integrated mills and foreign producers, the traditional providers of such products to the U.S. market.[129]

In response to the combined effects of foreign and domestic competition on their domestic market share, the major integrated producers have revised their marketing strategy so as to capture the higher-value market segments. Ultimately, this strategy could prove useful in establishing the leading global steel competitors: those who can best respond to the dynamic changes likely to occur in the world market.

The industry has also implemented programs to improve quality that are not capital based. These include the implementation of product quality guarantees, such as the one offered by LTV Steel, which guarantees replacement of steel at no cost to the customer if the customer is not satisfied with the material. The customer determines whether or not the steel quality is satisfactory and the guarantee covers the material for 1 year from the date of shipment. All of LTV's flat-rolled products as well as its line of prime mechanical tubing and electrical conduit products are covered by the guarantee.[130] Companies have also adopted new philosophies of operation designed to achieve quality output in all phases of the production process, such as Bethlehem Steel's Total Quality Process program, under which the concept of continuous quality improvement encompasses all employees (hourly and salaried) and all phases of production.

Current Status of the U.S. Industry

As the foregoing suggests, the U.S. industry has taken a number of steps to improve its product quality and customer service. In order to gain insights into the degree to which changes have been made, and insights into the current competitive position of the U.S. industry relative to its foreign counterparts, the Commission surveyed a group of companies representing different types of steel purchasers. In addition, U.S. steel producers were requested to provide a

[129] U.S. International Trade Commission, *Annual Survey Concerning Competitive Conditions in the Steel Industry and Industry Efforts to Adjust and Modernize*, USITC publication 2226, October 1989, p. 22.
[130] "LTV Steel Broadens Its Quality Guarantee", *American Metal Market*, Apr. 10, 1990.

self-evaluation of their company's respective performance. The results of the survey are summarized in tables 22–25. More detailed results, compiled on the basis of individual product groups and by country, are presented in appendix E.

A range of 82–93 percent of purchaser and producer respondents to the Commission's questionnaire reported improvements in quality (table 23) by U.S. producers of carbon and alloy flat-rolled (plates, sheets, and strip) and long products (bars, rods, shapes, and rails).[131] This is consistent with investments made by the industry in equipment such as continuous casters and vacuum degassers, which improve product quality by improving steel's metallurgical composition, surface appearance, and formability (see discussion, "Modernization," for further details on the nature of steelmakers' investments).

The views of producers and purchasers regarding the degree to which quality improvements were made by the U.S. industry differed markedly in carbon and alloy pipes and tubes (table 23). Within this product category, 76 percent of producers viewed themselves as having made significant quality improvements whereas only 17 percent of purchasers observed similar improvements. Producers of stainless and alloy tool steel products also tended to rate themselves as having made more significant improvement than did purchasers: 89 percent of stainless flat-rolled producers and 59 percent of stainless long products producers viewed their overall improv ments as significant compared to only 28 perce and 21 percent of purchasers, respectively. Sp cific differences in quality characteristics th might explain these divergent views are not rea ily apparent; however, it appears that purchase may have a different frame of reference. Japan the only steel supplier receiving a substantial le of excellent ratings from purchasers (25–59 pe cent) on overall steel product quality (see belov This tends to suggest that purchasers may not y have experienced the degree of consistent qual performance over time from U.S. producers th they have experienced from Japanese produce and that this may have influenced their evaluati of the extent of producers' improvements.

Producer respondents (ranging from 91–1 percent) reported limited to significant improv ments in customer service (table 24) by U. producers of carbon and stainless steel mill pro ucts, compared with 74–83 percent of purcha respondents. For each product category, exce stainless long products, 50 percent or more of r sponding producers rated their over improvements in customer service as significa The majority of purchasers, however, observ only limited improvements in customer servic The fact that purchasers perceived more limit quality and service improvements than did pr ducers could reflect the fact that while produce have spent considerable sums in upgrading equ ment (resulting in "significant" improvemer from this perspective), they still fall short of pu chasers' more demanding requirements (th resulting in only "limited" improvements fro their perspective).

[131] Steel produced by U.S./Japan joint venture operations in the United States is also included in the assessments of product quality and customer service.

Table 23

Assessments of the extent to which U.S. steel producers improved their overall product quality from Jan. 1, 1985 to April 1990

Item	Degree of improvement:			
	Little or None	Limited	Significant	No. of respons
	Percent			
Producers' assessment:				
Carbon and certain alloy steel:[1]				
Plates, sheets and strip	8	39	54	39
Bars, rods, shapes and rails	9	46	46	66
Pipes and tubes	3	21	76	29
Stainless and alloy tool steel:				
Plates, sheets and strip	0	11	89	19
Bars, rods, and shapes	6	35	59	17
Pipes and tubes	(2)	(2)	(2)	(2)
Purchasers' assessment:				
Carbon and certain alloy steel:[1]				
Plates, sheets and strip	12	49	38	178
Bars, rods, shapes and rails	18	56	26	125
Pipes and tubes	26	57	17	84
Stainless and alloy tool steel:				
Plates, sheets and strip	19	53	28	68
Bars, rods, and shapes	19	60	21	48
Pipes and tubes	29	46	25	28

[1] Certain alloy refers to alloy steel other than stainless or tool steel.
[2] Insufficient response provided.
Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table 24

Assessments of the extent to which U.S. steel producers improved their overall customer service from Jan. 1, 1985 to April 1990

Item	Degree of improvement: Little or None	Limited	Significant	No. of responses
	Percent			
Producers' assessment:				
Carbon and certain alloy steel:[2]				
Plates, sheets and strip	10	32	59	41
Bars, rods, shapes and rails	4	46	50	68
Pipes and tubes	7	18	75	28
Stainless and alloy tool steel:				
Plates, sheets and strip	0	37	63	19
Bars, rods, and shapes	0	53	47	17
Pipes and tubes	[3]	[3]	[3]	[3]
Purchasers' assessment:				
Carbon and certain alloy steel:[2]				
Plates, sheets and strip	17	61	22	179
Bars, rods, shapes and rails	18	59	24	130
Pipes and tubes	20	61	19	85
Stainless and alloy tool steel:				
Plates, sheets and strip	17	61	22	69
Bars, rods, and shapes	19	60	21	52
Pipes and tubes	26	48	26	31

[1] Limited improvements were further defined in the questionnaire as follows: customer satisfaction has risen, but certain aspects still need improvement. Significant was further defined as follows: customer satisfaction has risen appreciably with regard to all aspects of the service.

[2] Certain alloy refers to alloy steel other than stainless or tool steel.

[3] Insufficient response provided.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

In addition to evaluating the degree of improvement, companies surveyed were also requested to evaluate the current competitive position of U.S. and foreign producers. According to U.S. purchasers, Japan more consistently offers a higher quality product (rated good to excellent by the majority of respondents) than does the United States (rated satisfactory to good) (table 25). Japan is the only supplier receiving excellent ratings from a majority of purchasers on overall steel product quality; this occurred in two product categories, carbon and alloy long products (59 percent excellent) and stainless and alloy long products (55 percent). However, U.S. stainless flat-rolled product quality is rated good to excellent by 63 percent of responding purchasers and is considered somewhat better than that of Japan (58-percent good/excellent) and other global producers. U.S. producers' self-evaluation of their achieved level of product quality placed them strongly in the "good" quality category with responses ranging from 50–76 percent.

Japan showed more moderate strength relative to the U.S. industry in results reported by purchasers for customer service, although Japan's service performance was ranked slightly lower than its quality performance (table 25). U.S. industry customer service is rated good by 43–51 percent of purchaser respondents and considered to be comparable with Japan and other global producers for three product segments: carbon and alloy long products, and for stainless and alloy flat-rolled and long products. A majority of purchasers rated Japanese producers good-to-excellent on customer service for two product segments: carbon and alloy flat-rolled products (66 percent of respondents) and carbon and alloy pipe and tubes (80 percent of respondents). Domestic producers assessed their service performance at somewhat higher levels, with the majority of respondents (57–75 percent) reporting good performance for each product line.

As noted, purchasers' consistently rising expectations with regard to product quality and customer service may have contributed to their relatively lower evaluation of producers' performance. Purchasers in the automotive industry (major consumers of carbon and alloy flat-rolled steel) have been an important force behind producers' efforts to improve product quality and service. As shown in table 25, carbon flat-rolled product quality was rated as good/excellent by 53 percent of purchasers who evaluated U.S.quality and 83 percent of purchasers who evaluated Japanese quality. Similarly, 49 percent of respondents rated U.S. carbon flat-rolled product producers' customer service as good/excellent as compared with 66 percent for Japanese service (table 26). However, an examination solely of responses by automotive industry consumers reveals little difference in performance between U.S. and Japanese producers, suggesting that U.S. producers have focused their improvement efforts on their biggest customers.

Table 25

Assessments[1] of overall steel product quality,[2] by country, April 1990

Product/country	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
	Percent				
Carbon and certain alloy steel:[3]					
Plates, sheets and strip:					
Producers' assessment:					
United States	2	17	69	12	42
Purchasers' assessments:					
United States	2	45	50	3	175
Brazil	25	56	19	0	16
Canada	0	38	50	12	34
Japan	0	17	48	35	60
Bars, rods, shapes and rails:					
Producers' assessment:					
United States	0	15	71	14	65
Purchasers' assessments:					
United States	2	42	48	8	132
Canada	0	30	60	10	30
Japan	0	13	28	59	32
United Kingdom	0	30	57	13	23
Pipes and tubes:					
Producers' assessment:					
United States	0	3	69	28	32
Purchasers' assessments:					
United States	1	41	44	14	86
Japan	0	7	47	47	15
Stainless and alloy tool steel:					
Plates, sheets and strip:					
Producers' assessment:					
United States	0	14	76	10	21
Purchasers' assessments:					
United States	4	33	56	7	72
France	0	39	39	23	13
Japan	8	33	33	25	12
Bars, rods, and shapes:					
Producers' assessment:					
United States	0	30	55	15	20
Purchasers' assessments:					
United States	0	46	52	2	46
Japan	0	27	18	55	11
Pipes and tubes:					
Producers' assessment:					
United States	0	25	50	25	4
Purchasers' assessment:					
United States	0	55	35	10	29

[1] Assessments of U.S. and foreign countries' performance were made by purchasers for companies with whom they conducted business. U.S. producers (steel companies) were requested to provide a self-evaluation of their company's respective performance.

[2] The term "satisfactory" was further defined in questionnaires as follows: periodic problems encountered, but problems are effectively resolved. "Good" was further defined as "occasional minor problems." "Excellent" was defined as "virtually no problems encountered."

[3] Certain alloy refers to alloy steel other than stainless or tool steel.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

le 26

essments[1] of the overall customer service provided to steel purchasers,[2] by country, April 1990

duct/country	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
	Percent				
bon and certain alloy steel:					
ates, sheets and strip:					
Producers' assessment:					
United States	0	22	63	15	41
Purchasers' assessments:					
United States	7	44	43	61	75
Brazil	25	50	19	6	16
Canada	6	47	44	3	32
Japan	5	28	53	13	60
ars, rods, shapes and rails:					
Producers' assessment:					
United States	0	7	63	31	62
Purchasers' assessments:					
United States	4	37	47	12	135
Canada	0	47	37	17	30
Japan	0	35	38	27	34
United Kingdom	13	58	17	13	24
pes and tubes:					
Producers' assessment:					
United States	0	36	63	1	29
Purchasers' assessments:					
United States	6	30	52	12	90
Japan	7	13	53	27	15
nless and alloy tool steel:					
ates, sheets and strip:					
Producers' assessment:					
United States	0	19	57	24	21
Purchasers' assessments:					
United States	5	40	46	9	76
France	20	47	3	30	15
Japan	6	50	38	6	16
ars, rods, and shapes:					
Producers' assessment:					
United States	0	22	61	17	18
Purchasers' assessments:					
United States	4	41	51	4	51
Japan	0	43	43	14	14
pes and tubes:					
Producers' assessment:					
United States	0	25	75	0	4
Purchasers' assessment:					
United States	15	35	44	6	34

[1] Assessments of U.S. and foreign countries' performance were made by purchasers for companies with whom conducted business. U.S. producers (steel companies) were requested to provide a self-evaluation of their pany's respective performance.

[2] The term "satisfactory" was further defined in questionnaires as follows: periodic problems encountered, but blems are effectively resolved. "Good" was further defined as "occasional minor problems." "Excellent" was ned as "virtually no problems encountered."

[3] Certain alloy refers to alloy steel other than stainless or tool steel.

rce: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

The findings with respect to the quality of l supplied to customers correspond to that deped by the Auto/Steel Partnership's Task ce on Uniformity of Materials Properties in an oing study that statistically measures and charerizes the current levels of variability in chanical properties of steel sheet. Sheets from eral North American producers as well as one st German and two Japanese producers were luated. One of the report's findings is that the anese electrogalvanized product exhibits a ner level of variability than Japan's current utation would indicate. Moreover, certain l parts sampled from North American sources ibited excellent consistency and control, surging the best of the Japanese. In addition, the report found that the majority of the North American producers are generally competitive with offshore sources.[132]

Trends and Developments in the International Steel Industry

Internationalization

As world steel markets strengthened during the late 1980s, the volume of steel traded interna-

[132] Task Force on Uniformity of Materials Properties, Auto/Steel Partnership Program, *A Report on the Uniformity of Automotive Sheet Steels*, May 1990, p. 1-1.

tionally increased, rising from 140–160 million short tons in the late 1970s to 188 million tons in 1988.[133] Despite this growth, changes in the share of steel traded actually rose relatively little, increasing from 24 percent of finished steel production in the late 1970s to 26–27 percent in the latter part of the 1980s. Tariff and nontariff barriers that affected the terms under which steel could be traded appear to have been factors contributing to the relative stability in the share of production traded during this period.

Although the role of trade has been relatively stable, the industry has nonetheless become more internationalized. While technology and raw materials have long been freely exchanged among producers worldwide, production facilities have generally been owned and operated by domestic companies (i.e., there was relatively little foreign investment). This situation changed during the 1980s. The change was particularly pronounced in the United States, where Japanese, Korean and French steelmakers entered into joint ventures with U.S. steelmakers and/or purchased equity interests in existing facilities. In 1989 alone, eight major U.S. companies signed joint-venture agreements with foreign partners.

While perceived cost advantages and trade restraints that affected the ability of countries to export to foreign markets undoubtedly influenced decisions to invest in foreign countries, another important element appears to have been the growing importance of being proximate to end users, both for logistic reasons and to cultivate closer working relations with consumers as they develop and refine their products.[134]

In future years the process of internationalization appears likely to continue, though perhaps in a somewhat different form. On the trade front, the lowering of tariff and nontariff barriers,[135] privatization of state-owned firms, and liberalization of steel markets are likely to create new opportunities for trading steel. Increased specialization among firms could well expand such opportunities. In Japan, for example, integrated producers have focused their attention on higher value steel products, a strategy that has created opportunities for countries exporting hot-rolled bands and plates. As a result, imports now account for about 9 percent of Japanese apparent steel consumption (1988), as compared to 4 percent in 1985.

Foreign investment appears likely to contin with attention expanding to countries other th the United States.[136] The Far East (e.g., Mal sia, Indonesia, and Thailand) appears to be region of growing activity, as does East Europe.[137] With respect to the latter, East Europe (i.e., Poland, Hungary, Romania, E Germany, Czechoslovakia, and Bulgaria) tracted some joint venture interest in 19 primarily between Western European firms a Hungary. The dated technology being used[138] these countries, however, suggests that foreign vestment may be limited to a few select plant

Capacity, Production, and Consumption

Capacity and Investment

World raw-steelmaking capacity in 1989 taled approximately [* * *] short tons[139] and divided among the industrialized, developing, a nonmarket economy (NME) countries as sho in the tabulation on the top of the next page

Among industrialized countries, raw steelm ing capacity in 1989 was concentrated in European Community (EC) ([***] percent of dustrialized country capacity), Japan percent), and the United States (21 percent). the developing countries, the majority of steelmaking capacity in 1989 was located in Br ([***] percent of developing country capaci Korea ([***] percent), India ([***] perce and Mexico ([***] percent). The Soviet Un accounted for more than half ([***] percent raw steelmaking capacity in the nonmarket ec omy countries in 1989 (appendix F, table F-

Capacity reduction in the industrialized co tries, which has been significant during the 19 will likely slow over the next few years, as resti turing efforts undertaken by Japan, the EC, the United States to reduce the size of their dustries approach th goals. In Japan, rationalization plans ani ounced by the major tegrated producers in lat 1986 are still expec to occur, but have bee.n postponed to 1990–92 time period in light of relatively str market conditions in that country.[140] In the

[133] Data on international steel trade from the International Iron and Steel Institute, *Steel Statistical Yearbook 1989*, Brussels 1989, p. 33.

[134] See discussion of the auto/steel partnership in section on "Actions to Improve Product Quality and Customer Service."

[135] For example, Mexico decreased average tariffs for steel products from a high of 50 percent in the early 1980s to a current top rate of 15 percent; moreover, Korea instituted new tariff rates in 1989 (which currently range from 2 to 10 percent) that are less than half the previous rates.

[136] See appendix F and section on "Joint Ventures

[137] Discussions with William T. Hogan, S.J., Fordham University, July 1990.

[138] About 35 percent of steel production is prod. e by the open hearth method, for example, compare less than 2 percent in industrialized countries. More the countries collectively continuously cast only abou percent of steel production in 1988, as compared to percent in industrialized countries.

[139] Reported data may be overstated. In the case o Japan, for example, Commission fieldwork conducte October 1989 suggests that actual Japanese steelmaki capacity may currently be 120–125 million short tons

[140] World Steel Dynamics, "Global Steelmaking Capacity Track: Capacity Monitor #5", March 20, 1989.

	Raw steelmaking capacity in 1989[1]	Raw steelmaking production in 1989[2]	Capacity Utilization in 1989
	(Million short tons)		(Percent)
ıdustrialized countries:			
EC (12)	[***]	154.6	[***]
Japan	158.0	118.9	75
United States	115.9	97.4	84
Other	[***]	64.7	[***]
Subtotal	[***]	435.6	[***]
eveloping countries:			
Brazil	[***]	27.6	[***]
South Korea	[***]	24.1	[***]
India	[***]	15.9	[***]
Other	[***]	44.2	[***]
Subtotal	[***]	111.8	[***]
onmarket economy countries:			
Soviet Union	[***]	176.5	[***]
Eastern Europe[3]	[***]	63.8	[***]
People's Republic of China	[***]	67.5	[***]
Other	[***]	8.1	[***]
Subtotal	[***]	315.9	[***]
Total	[***]	863.3	[***]

[1] Compiled from data collected by the Organization for Economic Co-operation and Development (OECD), and * *.

[2] International Iron and Steel Institute, Steel Statistical Yearbook, 1989.

[3] Includes Poland, Romania, Czechoslovakia, the German Democratic Republic, Hungary, Bulgaria, and Albania.

xcess steelmaking capacity still exists, and the ıture of major mills such as Finsider's Bagnoli 'orks in Italy and BSC's Ravenscraig plant in the Jnited Kingdom remains uncertain. In its forecasts for the next 5 years, "General Objectives teel 1995," the EC Commission noted that the eversing mill plate and heavy and light sections roduct areas of the EC steel industry would face ıe largest imbalances between demand and poential supply, necessitating further restructuring ı these areas.[141] Some capacity reduction is also xpected in Austria and Sweden, whereas Turkey nd Yugoslavia have announced plans to expand apacity by at least 1.0 million short tons each ›ver the next 5 years.[142] Steelmaking capacity in * * *] is expected to [* * *] in the near uture.[143]

In the developing countries, expansion is exected to continue, partly as a result of growing ıternal demand for steel.[144] More than [* * *] hort tons of capacity has been built in [* * *], nd [* * *]. South Korea's Posco recently comleted its third stage of expansion (adding 3 ıillion short tons) and announced plans for a ɔurth stage, and China Steel in Taiwan increased apacity by about 1.5 million short tons at its .aohsiung works. [* * *].[145] Less capacity rowth is expected in Latin America where economic difficulties in Brazil, the region's largest steel-producing country, and Venezuela have called funding for such expansion into question.

With respect to the nonmarket economy countries, capacity expenditures in Eastern Europe[146] over the next few years will likely be directed toward modernization and rationalization, with capacity likely to decline. Significant capacity growth could occur in the PRC where plans to increase capacity by [* * *] short tons have been announced.[147] The growing capacity will likely supply internal demand for steel, thereby reducing the country's import dependence.

Sheet products continued to be the primary area of investment by steel companies around the world, largely because of their higher value and wide applications. Much of the investment that has occurred was designed to improve product quality, and increase facility productivity and energy efficiency. Companies worldwide continued to increase their use of continuous casters, which are used to produce higher quality semifinished steel for further processing.[148] The investment has also included the acquisition of vacuum degassers, ladle metallurgy stations and other technologies to produce higher-value, clean steel. Announcements by the Japanese and European

[141] *Metal Bulletin*, "More Closures Needed, EC ays", April 26, 1990.

[142] World Steel Dynamics, "Global Steelmaking apacity Track: Capacity Monitor #5", March 20, 989.

[143] OECD Working Papers, July 19, 1989 and April 990.

[144] World Steel Dynamics, "Global Steelmaking apacity Track: Capacity Monitor #5", March 20, 989.

[145] OECD Steel Committee, [* * *].

[146] Includes Albania, Bulgaria, Czechoslovakia, German Democratic Republic, Hungary, Poland, and Romania.

[147] OECD Steel Committee, [* * *].

[148] The United States' industry continuously cast 64.6 percent of steel production in 1989, compared to 93.5 percent for Japan, and 84.2 percent for the EC; Brazil continuously cast 49 percent in 1988. In addition to improving product quality, continuous casting is estimated to save between $30 and $50 per metric ton on production costs for sheet products.

industries and others indicate that future emphasis will also be directed to this area.[149] For many countries (particularly industrialized countries), this will apparently take the form of investment in more sophisticated processing technology; for others (particularly developing countries), it will most likely include the construction of new facilities (appendix F, Table F-3).

All major producing areas also experienced significant investment in galvanizing lines for sheet products during 1989. Steel companies in North America, the Caribbean, Japan, Latin America, Taiwan and Europe have announced installation of 26 new galvanizing lines by 1992 with the goal of providing coated products for automotive, appliance and construction applications.[150] These new facilities will provide an estimated 60-percent increase in global galvanized capacity; as a consequence, some analysts project an eventual oversupply of coated products.[151]

Production

World raw steel production in 1989 totaled slightly more than 863 million short tons. As is the case with capacity, the industrialized countries accounted for the majority of production (50.5 percent), compared with 12.9 percent for developing countries and 36.6 percent for nonmarket economy countries (appendix F, table F-2).

Aggregate capacity utilization rates in 1989 were the highest in the nonmarket economy countries ([* * *] percent), followed by the developing countries ([* * *] percent), and the industrialized countries ([* * *] percent) (appendix F, table F-2). The relatively high overall capacity utilization rate in the nonmarket economy countries is influenced largely by [* * *]. In the developing countries, capacity utilization rates in [* * *]. In the industrialized countries, the capacity utilization rate of the United States was 84 percent, compared with 75 percent in Japan and [* * *] percent in the EC.

Apparent Consumption

Apparent world consumption of finished steel mill products[152] in 1988 totaled just over 720 million short tons. The industrialized countries accounted for 49 percent compared with 15 percent for developing countries and 36 percent for nonmarket economy countries, as shown in the tabulation at the bottom of the page.

The distribution of consumption between the three country groups is similar to that for world production. More detailed consumption data are presented in appendix F, table F-4.

Slight declines in apparent consumption in the industrialized countries are likely in 1989 and 1990, in response to declines in demand from the auto, construction, and appliance markets in the United States, Canada, and the EC.[153] In Japan there will likely be some increase in demand for steel, reflecting relatively stable demand from the automotive industry and growth in steel consumption by the nonresidential construction and machinery industries.[154] Developing countries

[149] *American Metal Market*, Mar. 27, 1990 and *Metal Bulletin*, Mar. 15, 1990.

[150] The U.S. industry has announced plans for installation of 8 coating facilities, to be brought on line by 1992 (see Investment in New Equipment)..

[151] Remarks made by various speakers at Steel Survival Strategies V, June 26-27, 1990.

[152] Finished products are those produced by processing raw steel (i.e., semifinished steel slabs and the like) into the more advanced shapes (such as sheets and plates) typically sold by mills to steel users.

[153] OECD, *The Steel Market in 1988 and the Outlook for 1989*, 1989; and OECD Steel Committee, [* * *].

[154] Discussion between commission staff and Japanese steel industry officials on June 21, 1990.

	Apparent consumption of finished steel in 1988[1]	*Share of total*
	(Million short tons)	*(Percent)*
Industrialized countries:		
EC (12)	116.4	16.01
United States	89.2	12.4
Japan	99.8	13.9
Other	47.9	6.7
Subtotal	353.3	49.1
Developing countries:		
South Korea	16.0	2.2
India	15.8	2.2
Brazil	11.8	1.6
Other	61.0	8.5
Subtotal	104.6	14.5
Nonmarket economy countries:		
Soviet Union	143.5	19.9
People's Republic of China	61.6	6.9
Eastern Europe	49.8	8.6
Other	7.5	1.0
Subtotal	262.4	36.4
Total	720.3	100.0

[1] International Iron and Steel Institute, Steel Statistical Yearbook, 1989.

will likely experience mixed trends in consumption. Weakness in economies in certain Latin American countries could depress domestic demand, whereas rapid growth in automotive and construction activity in Southeast Asian countries such as Korea and Taiwan could spur sizeable increases in consumption.[155] In the nonmarket economy countries, particularly in Eastern Europe, sluggish conditions and uncertainty in the economy will likely result in declining consumption in the near term.

Trade

World exports of steel are dominated by the industrialized countries, which accounted for about 69 percent of total world exports in 1988, compared with 16 percent for developing countries and 15 percent for nonmarket economy countries (appendix F, table F-5). A total of 12 countries exported 50 percent or more of their production that year. In contrast, only four countries exported less than 10 percent of their production: the Soviet Union (5.8 percent), the United States (2.1 percent), India (0.8 percent), and the Peoples' Republic of China (0.3 percent). The United States' ratio is low relative to other major industrialized country producers such as Japan (22.1 percent) and the EC (51.0 percent). Although U.S. exports have traditionally accounted for only a small portion of total output, they nonetheless more than doubled from 1988 to 1989 to a level of 4.8 million short tons. U.S. exports have benefitted from exchange rate fluctuations which have made them more price-competitive in foreign markets and from improved product quality and more accessible channels of distribution.

Imports are not as concentrated among countries as are exports. The United States, West Germany, and the Soviet Union, together, accounted for 26 percent of world imports in 1988 (appendix F, table F-6). Imports' share of domestic consumption for the industrialized countries as a whole was 30 percent in 1988, compared with 39 percent for the developing countries and 14 percent for the nonmarket economy countries. Three-fourths of the industrialized countries, many of which imported relatively small quantities of steel, imported in excess of 30 percent of their domestic requirements in 1988. In contrast, the United States, the world's largest importing country, imported 21 percent of its domestic requirements, although West Germany, the second largest importing country, relied on imports to supply 46 percent of its consumption. Another large importer, Japan, recorded import penetration of 9 percent in 1988. Among the developing countries, Taiwan, the largest importer, also derived the largest share of domestic consumption (56 percent) from imports. This relationship was not consistently observed for the nonmarket economy countries, where the largest importers, the Soviet Union and the PRC, exhibited import shares of 8 percent and 16 percent, respectively (appendix F, table F-6).

In 1988, about half of the steel-trading countries experienced trade surpluses, ranging in magnitude from a low of 419,000 short tons (Hungary) to a high of 18.0 million short tons (Japan) (appendix F, table F-6). Other countries experiencing significant trade surpluses in 1988 include Brazil (the second-largest net exporter), Belgium-Luxembourg, and West Germany. The largest trade deficit was experienced by the United States (19.1 million short tons), followed by China (9.8 million short tons) and Taiwan (4.0 million short tons).

Financial Conditions

Steel producers in industrialized countries experienced a profitable year in 1988 (table 27), attributable largely to growth in demand for steel coupled with increases in facility efficiency. Usinor/Sacilor, France's major producer, posted the largest profit of major companies in any industrialized country in 1988; its $737.5 million in profit represented a return on sales of 5.6 percent. The company's profitability reflects not only the effects of relatively strong market conditions, but also the effects of closures of obsolete works, reductions in employment, and divestiture of businesses not directly related to steel. The return to profitability represents a significant improvement in the overall financial performance of France's steel industry since the early 1980s, when industry losses were sizeable.[156] The largest return on sales in 1988 (26.6 percent) was earned by a developing-country producer, Taiwan's China Steel. The profitable performance resulted largely from growing demand for steel in its home markets, competitive costs, and strong export markets.[157]

The weakest financial performance in 1988 was by Siderbras in Brazil, which recorded a loss of $7.2 billion on sales of $5.2 billion. The firm's losses resulted primarily from Brazil's relatively unstable economy and a sharp decline in demand for steel.[158]

Pricing Trends

A firming of the U.S. dollar combined with a weakening in demand, has contributed to an erosion in world export prices since early 1989.[159]

[155] OECD, *The Steel Market in 1988 and the Outlook for 1989*, 1989; and OECD Steel Committee [* * *].

[156] See *Steel Times*, August 1989.

[157] See *Metal Bulletin*, "Taiwanese output surges," Ap. 3, 1989.

[158] Paine Webber, "World Steel Intelligence: Price Track 31," April 23, 1990.

[159] World export prices are generally denominated in U.S. dollars. Paine Webber, "World Steel Intelligence: Price Track 31," April 23, 1990.

Table 27
Sales and profits of selected international steel producers, 1988
(In millions of dollars)

Country/company	Sales	Profit (loss)[1]	Net profit or (loss) as a percent of sales
Brazil:			
Siderbras	5,120.6	(7,192.8)	(140.5)
Canada:			
Dofasco	2,418.2	180.0	7.4
Stelco	2,198.5	78.5	3.6
Subtotal	4,616.7	258.5	5.6
Finland:			
Outokumpu	2,315.1	38.9	1.7
France:			
Usinor/Sacilor	13,247.1	737.5	5.6
Japan:			
Nippon Steel	17,108.9	291.7	1.7
NKK	8,276.0	122.4	1.5
Sumitomo Metal Industries	7,675.5	20.7	0.3
Kobe Steel	7,631.9	34.9	0.5
Kawasaki Steel	7,333.1	62.9	0.9
Nisshin Steel	2,698.2	99.7	3.7
Sumitomo Heavy Industries	2,062.8	3.2	0.2
Subtotal	52,786.4	635.5	1.2
Sweden:			
Sandvik	2,675.3	209.8	7.8
Taiwan:			
China Steel	1,537.9	409.5	26.6
United Kingdom:			
British Steel	7,009.8	698.3	10.0
United States:			
Bethlehem Steel	5,488.8	403.0	7.3
National Steel	2,599.1	88.2	3.4
Weirton Steel	1,383.9	75.0	5.4
Allegheny Ludlum Corp	1,207.5	108.6	9.0
Nucor	1,061.4	109.4	10.3
Subtotal	11,740.7	784.2	6.7
West Germany:			
Thyssen	16,796.0	372.3	2.2
Krupp	8,385.4	(153.4)	(1.8)
Klockner	2,408.4	0.2	(2)
Subtotal	27,589.8	219.1	0.8

[1] Profits are after taxes, minority interests, and extraordinary items.
[2] Less than 0.5 percent.

Source: *Fortune*, "The International 500", July 31, 1989; and "The Fortune 500: The Largest U.S. Industrial Corporations", April 24, 1989. Spot price comparisons for hot-rolled coil, cold-rolled coil, and galvanized sheet, June 1989, April 1990

Tables 28 and 29 indicate that U.S. spot prices for steel products in major markets generally softened during June 1989–April 1990, as did those in Japan and Canada (in terms of U.S. dollars). Those in the EC, while remaining the same or falling in terms of native currencies, rose in dollar terms. As a result, U.S. spot prices for sheet were lower than home market prices in Canada, the EC, and Japan, by at least 5 percent.[160] Plate product prices were higher only compared to dealer spot prices (denominated in dollars) in Japan, but lower than prices in Canada and the EC and Japan's "Big Buyer" prices. U.S. spot prices for rebar were lower, by at least 6 percent, than those for Canada, the EC, and Japan (table 29). The decline in automotive sales during 1989 has been a major factor negatively affecting steel prices (in particular, flat-rolled) in the United States, especially in the Midwest (the largest of the U.S. regional steel markets, and the country's major metalworking market). A fuller discussion of U.S. prices is provided above in the section entitled "Steel Pricing."

Following are summaries of steel pricing developments and conditions in Japan, Canada, and the EC:

[160] U.S. "spot" prices are for service centers and metal traders. European "spot" export quotes are obtained from either *Metal Bulletin* (of London) or *Echo de la Bourse* (of Belgium), based on prices agreed on by metal traders in Brussels.

able 28

pot price comparisons for hot-rolled coil, cold-rolled coil, and galvanized sheet, June 1989, April 1990

(U.S. dollars per short ton)

'arket	*Hot-rolled coil*		*Cold-rolled coil*		*Galvanized sheet*	
	June 1989	*April 1990*	*June 1989*	*April 1990*	*June 1989*	*April 1990*
anada[1]	403	370	504	482	705	654
C[2]	357	381	449	499	557	653
apan:						
Dealer	499	445	596	502	849	747
Big Buyer[3]	515	451	616	542	726	639
nited States[4]	390	310	500	460	620	620

[1] Reflects prices in Eastern Canada.
[2] Reflects German/French border prices.
[3] "Big Buyer" prices are those quoted to large steel consumers in Japan.
[4] Reflects prices in the Midwestern United States.

ource: World Steel Dynamics, "Steel Price Track 28", "Steel Price Track 31".

able 29

pot price comparisons for plate and rebar, June 1989 and April 1990

(U.S. dollars per short ton)

'arket	*Plate*		*Rebar*	
	June 1989	*April 1990*	*June 1989*	*April 1990*
anada	460	461	325	328
C[1]	368	432	315	346
apan:				
Dealer	427	359	376	359
Big Buyer[2]	518	456	[3]	[3]
nited States[4]	430	380	322	307

[1] Reflects German/French border prices.
[2] "Big Buyer" prices are those quoted to large steel consumers in Japan.
[3] Not available.
[4] Reflects prices in the Midwestern United States.

ource: World Steel Dynamics, "Steel Price Track 28", "Steel Price Track 31".

'apan

The Japanese steel industry is experiencing rowth in steel demand, as a result of governmenal spending on public works projects, rising apital spending, and increased private and public onstruction activity. Dealer prices, unchanged luring 1989, reportedly dropped (in dollar terms) n response to the weakening of the yen during arly 1990, making these prices more competitive n an international basis.[161]

Canada

In Eastern Canada, the country's primary teel-consuming market, the price of steel prodcts (in particular, prices for flat-rolled products nd structural shapes) has been adversely afected by reduced demand from the automotive nd construction markets. Plate prices have reortedly remained stable, largely due to sustained lemand from capital goods manufacturers. Impending labor negotiations at Stelco, a major flat-rolled producer, are expected to result in some hedge-buying by industrial consumers in the event of a work stoppage, which could raise prices for certain flat-rolled products.[162]

European Community

The European steel producers have reportedly maintained stable prices for most steel mill products, despite user inventory liquidations and a sharp drop in world export prices. Price stability has resulted from steady demand and a concerted effort beginning in early 1989 to reduce steel output in anticipation of declining demand, which EC producers are now experiencing. The greatest downward pricing pressure has been on hot-rolled sheet for which considerable intra-Europe competition has been reported by both mills and distributors.[163]

[161] World Steel Dynamics, "Steel Price Track 31", pril 23, 1990.

[162] Ibid.
[163] Ibid.

Comparative Costs

Depreciation of the dollar (which tended to increase foreign steelmaking costs in dollar terms)[164] and U.S. industry cost reductions helped to narrow the difference in average[165] integrated steelmaking costs[166] between U.S. and key foreign producers during 1984–90 (table 30). On an operating basis, most foreign producers' costs for cold-rolled sheet, a key product, are estimated to have been over $100 per ton (or more than 20 percent) lower than U.S. costs in 1984; by 1990 the difference with industrialized countries had narrowed to less than $40 per ton (or less than 10 percent). Developing countries, however, still maintained a considerable, albeit smaller, advantage.

Cost comparisons are more favorable to U.S. producers when financial charges such as depreciation and interest costs are included in computations; on this basis, U.S. costs (in 1990) are comparable to most of those of other industrialized producers, and less than 10-percent higher than estimated Korean and Brazilian costs.

[164] See appendix F, Figures F-1 and F-2.

[165] For those countries that have a number of operating mills, average costs do not capture the variation among companies or between different facilities operated by the same company. With the reorganizations that have occurred as a result of bankruptcies and the sale of facilities, the differences can be significant.

[166] Integrated steelmaking costs relate to facilities that produce steel by smelting iron ore and coke in blast furnaces. It does not, for example, include steel minimills, which produce steel in electric furnaces using ferrous scrap as a primary raw material.

[167] The WEFA Group estimated in a 1988 *Steel Market Intelligence Report* that depreciation charges for the 1981–85 period for U.S. mills average $28 per ton; in 1986–87, the charges rose to $35 per ton.

The lower, but rising[167] U.S. depreciation costs[168] reflect, in part, differences in the amount of capital investment for facility modernization and expansion in recent years. In Japan, for example, expanding demand for higher-grade, value-added steels has stimulated the construction of new facilities at an estimated cost of $3-4 billion annually,[169] with attendant high depreciation expenses. In contrast, the United States' relatively low depreciation figure is, in large part, a reflection of lower capital spending (see table 31).[170] In the future, it is likely that depreciation expenses of U.S. mills will increase, as older mills are forced to replace (or close) outdated equipment. Higher depreciation expense can be an advantage from a cash flow viewpoint, since it is a noncash expenditure that reduces reported income and, therefore, taxes.

A detailed breakdown of costs for May 1989 provides insights into the sources of cost differences among countries. As shown in table 32, advantages U.S. producers are estimated to have had with respect to labor productivity were offset by relatively high hourly labor costs. In addition, U.S. materials costs are estimated to have been the highest of the countries analyzed.

[168] Comparing industries' depreciation expenses between countries is difficult because of significant differences in accounting standards.

[169] This figure includes nonsteel related activities of the parent company.

[170] These figures do not represent total modernization expenditures, however, as some mills also lease equipment rather than purchase it outright. Such practices will also affect the depreciation expenses shown.

Table 30

Cold-rolled sheet: Pretax costs of integrated steelmakers, by country, mid-year, 1984-90, at actual operating rates

(Dollars per metric ton)

Country	1984	1986	1988	1989	1990
Operating cost:[1]					
USA	455	447	440	445	440
Japan	330	390	435	410	409
W.Germany	355	426	415	405	405
UK	340	360	375	380	413
France	355	395	385	390	415
Canada	400	400	410	420	430
S. Korea	310	305	330	350	350
Taiwan	325	325	340	360	355
Brazil	315	305	295	305	322
Total cost:[2]					
USA	500	489	480	486	485
Japan	420	515	535	505	490
W.Germany	395	420	475	425	480
UK	365	385	400	405	435
France	440	460	445	450	470
Canada	435	435	455	475	485
S. Korea	405	400	430	455	450
Taiwan	425	425	425	470	435
Brazil	435	425	425	435	450

[1] Excluding depreciation and interest.
[2] Including depreciation and interest.

Source: Economic Associates Inc., Dr. Donald F. Barnett, July 1990.

Steel investment: international comparisons, 1980-88 (million metric tons; million US dollars)

Country	*1980*	*1981*	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*Total, 1980-88*
United States:										
Capital spending	$2,651	$2,371	$2,258	$1,850	$1,203	$1,641	$862	$1,164	$1,836	15,836
Crude steel output	101.4	109.6	67.7	76.8	83.9	80.1	74.0	80.9	90.6	765.0
US dollars per ton	$26.1	$21.6	$33.4	$24.1	$14.3	$20.5	$11.6	$14.4	$20.3	20.7
EC:										
Capital spending	$3,443	$2,906	$2,505	$2,295	$2,324	$3,166	$4,081	$4,078	$3,495	28,293
Crude steel output	142.0	139.9	125.1	123.2	134.4	135.7	125.9	126.5	137.8	1,190.5
US dollars per ton	$22.2	$20.8	$20.0	$20.0	$17.3	$23.3	$32.4	$32.2	$25.4	23.8
Japan:										
Capital spending	$2,687	$3,601	$4,156	$3,702	$2,747	$2,701	$3,944	$3,398	$4,012	30,948
Crude steel output	111.4	101.7	99.5	97.2	105.6	105.3	98.3	98.5	105.7	923.2
US dollars per ton	$24.1	$35.4	$41.8	$38.1	$26.0	$25.7	$40.1	$34.5	$38.0	33.5
Latin America:										
Capital spending	$1,865	$2,488	$1,670	$1,959	$1,528	$1,193	$861	$1,099	$813	13,476
Crude steel output	28.9	27.0	26.7	28.7	33.2	35.8	37.4	39.7	42.4	299.8
US dollars per ton	$64.5	$92.1	$62.5	$68.3	$46.0	$33.3	$23.0	$27.7	$19.2	44.9

Note.—The countries presented here accounted for 48.4 percent of total world and 76.4 percent of western world crude steel output in 1989.

Source: Wharton Economic Forecasting Associates, April 1990.

Table 32

Certain integrated steel producers: Comparative pretax operating costs[1], May 1989

	USA	Japan	West Germany	U.K.	France	Canada	Australia	South Korea	Taiwan	Brazil	USSR (2)
Exchange rate (per $)	$1.00	139	DME1.97	0.62	f6.66	C$1.19	A$1.31	W664	NT$25.6	Ncr$1.09	R.62
Operating rate (percent)	95	85	95	95	95	95	95	100	100	100	100
	Dollars per metric ton shipped										
Raw materials:											
Iron ore to plant	43	33	35	32	32	41	33	33	34	20	23
Coal to plant	59	67	68	66	66	63	34	67	67	83	65
Scrap[3]	15	-5	-2	6	0	5	-	0	0	0	10
Other	186	195	184	189	184	168	194	192	182	143	202
Materials cost	303	290	285	293	282	277	261	292	283	246	300
Labor:											
Employment cost/hr	26	21	19	15	18	24	18	7	9	4	4
Man hours/metric ton	6.2	6.6	6.4	6.4	6.4	6.7	7.7	8.4	8.9	14.4	14.5
Labor cost	158	135	118	96	115	157	136	56	80	52	58
Operating costs:	461	425	403	389	397	434	397	348	363	298	358
Depreciation expense	25	75	37	18	28	27	25	85	71	85	44
Interest expense	9	20	14	1	16	16	28	17	11	45	-
Pretax operating costs	495	520	452	408	441	477	450	450	445	428	402

[1] Dollar figures for cold-rolled sheet per metric ton shipped.

[2] The USSR facility is Novolipetsk, which is 100% continuous cast. This is the best flat rolling plant in the Soviet Union.

[3] Integrated steel mills sometimes generate more scrap than they use.

Source: World Steel Dynamics, Cost Monitor #12, Nov. 13, 1989.

Raw Materials

Raw materials and their transformation to liquid steel account for about 55–70 percent of total production costs. For this reason, producers have targeted the blast furnace and its inputs for implementation of cost-reducing technologies to increase efficiency and reduce energy usage (see "Input Costs: Raw Materials"). During 1989, several U.S. companies moved closer to installation of pulverized coal injection systems (PCI) and mills in Korea and Taiwan also began installing PCI technology.[171] Currently, 58 percent of the operating furnaces in Japan use this technology and 50 percent or more of European capacity is likely to utilize coal injection by mid-1991. In the United States, only one company currently uses PCI. However if others proceed as planned, about 30 percent of domestic furnace capacity could use PCI by mid-1992.[172]

U.S. and European producers have also adopted new refractory materials for blast furnace relines. Designed to reduce maintenance and increase throughput efficiency, many of these materials have been adopted from Japanese companies that introduced both new refractory materials and artificial intelligence controls several years ago.

In Japan and the United States, additional cost reductions have been achieved by renegotiation of contracts for raw materials, including energy. Despite these renegotiations, however, U.S. mills apparently continue to have the highest energy costs of production of all major producing regions. In addition, U.S. mills have the highest iron ore costs of any producing region as domestic mills source much of their needs from relatively high cost North American mines (in which many companies have financial interests).

Worldwide raw material costs can be expected to increase in the future as environmental regulations in many producing countries become increasingly stringent and more rigorously enforced.[173] In Europe, for example,there was a rise of strong "green" coalitions in West Germany, the U.K., and Scandinavia in 1989 that sponsored legislation aimed at reducing pollution and addressing waste disposal problems. In the United States, pending clean-air legislation is anticipated to increase costs of coke production or acquisition, and energy costs. Moreover, grassroots environmental concern has been evident in Taiwan, Japan, and a number of other countries as well; this may well lead to expanded environmental requirements and expenditures, and, in some instances, off-shore expansion to avoid domestic public and legislative pressures.[174]

Labor

As employment in the steel industry worldwide has been pared and efficiency increased, the number of man hours per ton (mhpt) has fallen in all regions. Although U.S. mills currently are estimated to have one of the lowest mhpt levels, their slight edge could well be lost in the near future as mills in Japan and Europe continue to reduce their work forces and improve their productivity.[175] In Latin America, the recent move towards privatization of many steel plants introduces some uncertainty about future productivity for mills in this region. However, it seems certain that employment will be cut as mills move from state control to private management. In Brazil, for example, an estimated 40 percent of the current work force of 23,000 at Cia Siderurgica Nacional (CSN) may be cut in an effort to make the mill more efficient and, therefore, more attractive to investors.

During 1989, wage rates rose most dramatically in South Korea and Taiwan, somewhat negating the favorable labor cost positions held in past years.[176] They are, however, still far below those of all other producers except Brazil and mixed economy countries.[177] U.S. mills currently have the highest employee cost per hour, which will most likely go even higher as a result of the labor contracts concluded during 1989.

Available employment data indicate declines in the number of workers and in hourly compensation rates in industrialized countries during 1988–89 (table 33), indicative of these countries' efforts to reduce labor costs and improve operating efficiency. Declines in hourly compensation costs ranged from 0.3 percent in the United States, which recorded the highest such costs in 1989, to 2.8 percent in France. Increases in

[171] The use of pulverized coal injection technology (PCI) can reduce production costs $3 to $10 per ton. PCI replaces as much as 40 percent of the coke required for blast furnace operation with pulverized coal. The coal serves as a reducing agent as well as a substitute energy source, thereby reducing the energy required.

[172] Discussions with company officials, March 1990.

[173] According to U.S. and foreign industry spokesmen, current differences in environmental expenses may be due less to significant differences in the stringency of required controls than to variations in the level of enforcement.

[174] Taiwan's China Steel company had been planning a fourth phase of expansion, to begin in 1989. Due to public demands that the company consider the environmental impact of such expansion, China Steel began actively considering sites in other countries, including Canada, Australia, Brazil, Malaysia and the United States.

[175] In the case of Japan, rationalization plans were postponed because of a strong steel market in 1988–89 but it is likely that mills will begin to further reduce employment levels and improve labor productivity as operating rates decline. One independent analyst (World Steel Dynamics) estimates an additional 20–25 percent of the work force in Japan's steel industry may be cut by 1995.

[176] South Korean wage rates reportedly increased 100 percent (in won) during the last three years.

[177] "Mixed economy" refers to those countries formerly under planned, centralized economic structures which have recently introduced aspects of more market-oriented economic systems, e.g., Eastern European countries and the U.S.S.R. Estimated wage rates of $3–$6 per hour have been reported.

Table 33
Steel industry employment and wages in selected countries, 1988–89

Country	Employment 1988	Employment 1989	Hourly compensation costs[1] 1988	Hourly compensation costs[1] 1989
	1,000 workers		U.S. dollars	
Industrialized countries:				
Canada	(2)	(2)	18.83	20.15
EC (12):				
France	55.3	(2)	15.97	15.52
United Kingdom	55.2	(2)	13.41	13.25
West Germany	131.1	(2)	20.67	20.12
Other	173.9	(2)	(2)	(2)
Subtotal	415.5	[3]403.0	(2)	(2)
Finland	**	(2)	(2)	(2)
Japan	206.9	[3]199.0	22.80	22.40
Sweden	27.5	(2)	[4]18.68	[4]19.48
United States	213.0	(2)	23.57	23.49
Developing countries:				
Korea	(2)	(2)	4.47	6.35
Taiwan	(2)	(2)	[4]4.02	[4]5.19

[1] Costs are in current dollars. For each country, costs are converted at the annual average commercial exchange rate prevailing in that country during that year.
[2] Not available.
[3] January–September 1989.
[4] Includes employment in foundries.

Source: Data on number of workers compiled from data collected by the Organization for Economic Cooperation and Development. Hourly compensation data compiled from data collected by the U.S. Department of Labor, Bureau of Labor Statistics.

compensation costs were recorded in Canada of 7.0 percent and Sweden of 4.3 percent; however, these countries' costs remained below those of Japan and the United States in 1989.

By contrast, hourly compensation costs rose significantly in several developing countries during 1988–89. Those in Korea were up 42.1 percent in response to labor unrest, which reflected dissatisfaction with wages; in Taiwan, hourly costs were up 29.1 percent, largely in response to inflation. Despite the relatively sharp growth in compensation costs in these two countries, both continue to maintain their labor cost advantage over industrialized countries like the United States, where such costs are almost four times as great.

Financial

The capital-intensive steel industry is significantly influenced by the cost of capital. One study, for example, indicates that each percentage point change in interest rates is equivalent to 1 percent of the cost of producing of a ton of steel.[178] During 1989, as in past years, nominal long-term interest rates in the United States were among the highest of major industrialized countries, while short term rates were more competitive (see tabulation below). In addition, U.S. mills generally have low credit ratings and, therefore, found it difficult to secure large long-term borrowings on reasonable terms (see "Financial Conditions").

Research

As in the United States, joint research efforts continued in other countries in 1989 and largely focused on process-oriented research. In Japan, a 5-ton test furnace is currently being constructed as the first step in a 7-year, $28 million process technology research project; initial experimentation will focus on a smelting-reduction process which consolidates four steel processes into one. In Europe, the ECSC Iron and Steel Demonstration Program brings together three major European steelmakers to experiment with techniques to cut coal consumption by 50 percent. Joint efforts in the United States and elsewhere are focused on other major technological innovations such as direct steelmaking methods or thin-slab casting. While the United States' industry was outspent by those of several countries (most notably Japan), the ratio of professionally trained staff[179] compares favorably with producers abroad (see table 34).

[178] CRS report No. 85-738 E, *Hypothetical Effects of Lower Interest Rates on the Costs of Production of the Integrated Steel Industry.*

[179] Professionally trained staff includes scientists and engineers.

(Percent)

Country	Long-term interest rate						Short-term interest rate					
	1984	1985	1986	1987	1988	1989	1984	1985	1986	1987	1988	1989
United States	12.7	11.4	9.0	9.4	9.7	9.3	9.5	7.5	6.0	5.8	6.7	8.1
Canada	12.4	10.8	9.4	9.5	9.8	9.8	11.2	9.6	9.2	8.4	9.7	12.2
Japan	6.8	6.3	4.9	4.2	4.3	5.1	6.1	6.5	4.8	3.5	3.6	4.9
France	12.5	10.9	8.4	9.4	9.1	8.9	11.7	9.9	7.7	8.0	7.5	9.1
Germany	7.8	6.9	5.9	5.8	6.1	7.1	5.5	5.2	4.6	3.7	4.0	6.6
United Kingdom	10.7	10.6	9.9	9.5	9.4	9.6	9.3	11.6	10.4	9.2	9.8	13.0

Source: Wharton Economic Forecasting Associates, April 1990.

Table 34
Steel: Estimated research and development[1], selected countries, 1988

Country	Dollars per metric ton of crude steel	Percent of sales	Total R&D employees[2]	Professionally qualified (% of R&D Staff)
United States	118	.61	1,455	50
Canada	35	.25	191	52
U.K.	94	.55	2,547	41
Germany[3]	165	.61	2,700	30
France	153	.91	1,300	33
Japan	526	2.90	2,547	32
Korea	83	.87	354	50
Taiwan[4]	118	.87	191	60
India	[5]49	.27	1,197	33
Brazil	48	.39	495	30

[1] Excludes joint consortium efforts by companies.
[2] These figures may include staff assigned to the R&D unit but not engaged in R&D activities (i.e., grounds keeper, support staff, etc.).
[3] Data are for the year 1985.
[4] Data are for fiscal year 1986.
[5] Based on state-owned companies only.

Source: IISI, 1989.

Major Company Analysis

Cash Flow

To arrive at the statutory cash flow for the 9 major steel companies,[180] the Commission collected data on net income from steel product operations and the sources and uses of cash for the October 1, 1989–May 31, 1990, period (tables 35 and 36).[181] The net cash flow was calculated according to the definition provided in Public Law 98–573, section (b)(2)(B) (see table 37).[182]

For the period June 1, 1990–Sept. 30, 1990, companies were asked to estimate cash flow (not reflecting prior period activities or net increases in debts and liabilities). The 9 companies provided an estimate that totaled $177.8 million (see app. I, table I–6). Summing this estimate with cash flow over the October–May period results in a total period estimate of $1.3 billion.

[180] Major company is defined in the Steel Import Stabilization Act (Public Law 101-221) as "an enterprise that produces iron and steel and whose raw steel production in the United States during 1988 exceeded 000,000 net tons."
[181] Final data for the period October 1, 1988–September 30, 1989 are contained in appendix I, tables I-1 through I-5.
[182] Under Public Law 98-573, Section 806 (b)(2)(B), net cash flow is defined as "annual net (after tax) income plus depreciation, depletion allowances, amortization and changes in reserves minus dividends and payments on short-term and long-term debt and liabilities." It is not clear from the Act how certain data, such as net income from prior periods and increases in long and short term debt should be treated (see U.S. International Trade Commission, *Annual Survey Concerning Competitive Conditions in the Steel Industry and Industry Efforts to Adjust and Modernize*, USITC publication 2226, October 1989.

Table 35

Calculation of major companies' net income from steel product operations, October 1, 1989-May 31, 1990

(In thousands)

Item	Calculation
Net sales	$15,423,482
Cost of goods sold	13,926,341
General, selling, and administrative expenses	842,825
Interest expense	224,981
Reserves, provisions, special charges and other unusual items	(11,068)
All other expenses or (income)	(38,925)
Current income taxes	124,187
Tax effect of operating loss carry forward	(75,413)
Investment tax credit refund	0
Deferred taxes	1,725
Net income from steel operations	428,829

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table 36

Sources and uses of cash and cash equivalents in steel product operations, October 1, 1989-May 31, 1990

(In thousands)

Item	Calculation
Cash provided from (cash used in) operations:	
Net income	$428,829
Depreciation, depletion, and amortization	736,025
Noncash income tax expense	2,367
Noncash charges (credits):	
Relating to reserves, provisions, special charges and other unusual items	(47,601)
Other	90,663
Cash flow from earnings	1,210,283
Changes in working capital, excluding financing activities	249,354
Cash flow from operations	1,459,637
Cash provided from (used in) financing activities:	
Net additions to or (reductions) in long and short term debt	33,028
Changes in capital stock	(558,357)
Transfers from or (to) corporate	113,468
Other	(10,290)
Subtotal	(422,151)
Investment,[1] dividends paid, and other cash provided (used)	(1,632,663)
Increase (decrease) in cash and cash equivalents	(595,177)
Cash and cash equivalents:	
Beginning of period[2]	1,671,235
End of period[2]	1,076,058

[1] Includes capital expenditures and cash generated from the disposal of assets.
[2] [* * *]

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table 37

Calculation of major companies' cash flow on steel product operations,[1] Oct. 1, 1989-May 31, 1990

(1,000 dollars)

Item	Calculation
Cash flow from earnings	$1,210,283
Net changes in long and short term debt and liabilities[2]	[3]282,382
Dividends paid	(93,552)
Net cash flow from steel product operations[4]	[5]1,116,731

[1] Under P.L. 98-573, section 806 (b)(2)(B) net cash flow is defined as "annual net (after-tax) income plus depreciation, depletion allowances, amortization, and changes in reserves minus dividends and payments on short-term and long term debt and liabilities." The Conference report on the bill states that payment on short and long term debt and other liabilities means the net reduction in such debt and liabilities.
[2] Includes net changes in working capital.
[3] Calculated by summing net changes for all companies, including positive changes of $519.9 million and negative changes of $237.5 million.
[4] Including net income pertaining to prior periods, exclusion of which would reduce cash flow to $1,049.9 million.
[5] Since the net change in long and short term debt was positive, there was no "net reduction in short and long term liabilities". Net cash flow was therefore calculated as the sum of cash flow from earnings, minus dividends.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Cash Flow Commitments[183] [184]

During the period October 1, 1989–May 31, 1989, net steel-related expenditures[185] of the nine major steel companies amounted to $1.5 billion (see table 38). An additional $774 million of steel related expenditures was forecast by the nine companies for the June 1, 1990–Sept. 30, 1990 period (see app. I, table I-6).

Expenditures on Worker Retraining

Retraining of Current and Displaced Workers

As a group, the major integrated companies spent 6 percent of their adjusted net cash flow to retrain workers.[186] Substantially all of the steel industry's retraining expenditures appear to have funded the development of skills among currently-employed workers. As shown in table 39, the major integrated producers spent $54.3 million (99 percent) of total retraining expenditures to retrain current workers during October 1, 1989–May 31, 1990. The balance of retraining expenditures ($728,000) was spent to retrain displaced workers. Estimates for the 4-month period beginning June 1, 1990, indicate that expenditures to retrain current workers will continue to account for substantially all retraining expenditures.

Nature of Retraining

Information provided by the major integrated producers indicates that retraining efforts in 1989 principally focused on the development of technical steelmaking skills and the operation of modernized equipment. Such programs are designed to maximize the benefits derived from the implementation of quality-enhancing or labor-saving technologies. In addition, other, more transferable skills were introduced to workers. Among these were personal computer, data processing, masonry, electronic, welding, pipe-fitting, and air conditioning repair skills. Several companies also indicated that workers attended remedial reading and mathematic courses and received training to develop communicative and interactive skills.

Individual Company Retraining Programs

Each of the major integrated steelmakers spent more than 1 percent of adjusted net cash flow to worker retraining. A characterization of the retraining programs sponsored by each of the major integrated producers follows.

ARMCO Steel Company, L.P.

* * * * * * * *

Bethlehem Steel Corp.

* * * * * * * *

Inland Steel Company

* * * * * * * *

LTV Steel Corporation

* * * * * * * *

National Steel Corporation

* * * * * * * *

Rouge Steel Company

* * * * * * * *

United States Steel (USS) Div. of USX Corporation

* * * * * * * *

Weirton Steel Corporation

* * * * * * * *

Wheeling-Pittsburgh Steel Corporation

* * * * * * * *

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[183] Under the Trade and Tariff Act of 1984 (Public Law 98-573), as amended, the President is required to make an annual determination to the Committee on Ways and Means of the House of Representatives and the Committee on Finance of the Senate as to whether "the major companies of the steel industry, taken as a whole, have, during the 12-month period ending at the close of an anniversary referred to in the [Act],...committed substantially all of their net cash flow from steel product operations for purposes of reinvestment in, and modernization of that industry through investment in modern plant and equipment, research and development, and other appropriate projects such as working capital for steel operations and programs for the retraining of workers." Because of reporting time periods, the Commission focuses on data for the 8-month period October-May and reports estimates provided by the companies for the subsequent 4-month period June September.

[184] See appendix I for final data on the October 1, 1988–September 30, 1989 period.

[185] Net steel related expenditures are derived by deducting (from total expenditures) expenditures that were already reflected in the net income calculation used to determine net cash flow from earnings.

[186] In addition to the determination of cash flow commitments, the President is required to determine whether, "each of the major companies committed for the applicable 12-month period not less than 1 percent of net cash flow to the retraining of workers; except that this requirement may be waived by the President with respect to a major company in noncompliance, if he finds unusual economic circumstances exist with respect to that company."

Table 38

Major U.S. steel companies: Net cash flow from steel product operations, and steel-related expenditures, by company, Oct. 1, 1989-May 31, 1990

(In thousands of dollars)

Company	Net cash flow[1] (1)	Steel related expenditures: Plant and equipment (2)	Steel related expenditures: Research and development (3)	Steel related expenditures: Retraining workers[2] (4)	Steel related expenditures: Other (5)	Steel related expenditures: Total expenditures (6)	Expenditures reflected in net cash flow (7)	Net expenditures (6 - 7) (8)	Net increases in debts and liabilities (9)	Adjusted net cash flow (1+4-9) (10)	Expenditures for retraining workers as a percent of adjusted net cash flow (11)
Armco											
Bethlehem											
Inland											
LTV											
National	*	*	*	*	*	*	*	*	*	*	*
Rouge											
USX											
Weirton											
Wheeling-Pittsburgh											
Total	1,399,113[10]	1,473,783	85,650	55,024	65,181	1,679,638	156,922	1,522,716	542,413	911,724	6.0

[1] Including income pertaining to prior periods and net increases in short and long term debt and liabilities.

[2] Included as expenses in net income calculations.

3 * * *

4 * * *

5 * * *

6 * * *

7 * * *

8 * * *

9 * * *

[10] Including net increases in short term debt and liabilities of $282,382,000.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

able 39
xpenditures for the retraining of displaced and current workers, by company, by specified period

Company	Oct. 1, 1989–May 31, 1990	Estimate: June 1, 1990–Sept. 30, 1990	Total Oct. 1, 1989–Sept. 30, 1990
	1,000 dollars		
Displaced workers:			
Armco	*	*	*
Bethlehem	*	*	*
Inland	*	*	*
LTV	*	*	*
National	*	*	*
Rouge	*	*	*
USX	*	*	*
Weirton	*	*	*
Wheeling-Pittsburgh	*	*	*
Subtotal	728	212	940
Current workers:			
Armco	*	*	*
Bethlehem	*	*	*
Inland	*	*	*
LTV	*	*	*
National	*	*	*
Rouge	*	*	*
USX	*	*	*
Weirton	*	*	*
Wheeling-Pittsburgh	*	*	*
Subtotal	54,296	25,198	79,494
Total retraining expenditures:			
Armco	*	*	*
Bethlehem	*	*	*
Inland	*	*	*
LTV	*	*	*
National	*	*	*
Rouge	*	*	*
USX	*	*	*
Weirton	*	*	*
Wheeling-Pittsburgh	*	*	*
Total	55,024	25,410	80,434

Source: Compiled from responses to questionnaires of the U.S. International Trade Commission.

Executive Compensation

Direct compensation of steel industry executives in the form of salary (including the deferred portions of salary) constituted about 58 percent of total compensation at the nine major steel companies in 1989. Other direct compensation (i.e., bonuses and the like) totalled about 19 percent (table 40). Indirect compensation accounted for about 23 percent of total compensation. Total executive compensation represented 0.13 percent of total net sales[187] and 2.6 percent of general, selling, and administrative expenses (GS&A) of the nine companies.

Salaries of chief executive officers in 1989 ranged from [***] to [***], with an average of $441,000, compared to a 1988 median salary of $456,000 for CEOs in the primary metals (including steel) industry and $435,000 for CEOs in general manufacturing industries.[188]

The average of salaries and bonuses for (direct compensation) steel industry CEO's was $591,000. Median compensation levels for U.S. primary metals (including steel) and manufacturing industries were $678,000 and $654,000, respectively, in 1988.[189] Total compensation in 1989 for the CEOs at the nine major steel companies ranged from [***] to [***].

Average 1989 salaries of the 103 other executive officers at the major steelmaking companies ranged from [***] to [***]; average total compensation figures ranged from [***] to [***]. Average salary and compensation levels for other steel industry executives were comparable with those in primary metals (including steel) and manufacturing industries.[190]

[187] Total net sales include intra- and inter-company transfers.

[188] The Conference Board, *Top Executive Compensation: 1989 Edition*, p. 30. Data for 1989 are not yet available.

[189] Ibid.

[190] Ibid.

Actions Taken to Maintain International Competitiveness[19

The major companies[192] have been engag in a diverse group of actions aimed at improvi their competitive stance. All of the major comp nies have made capital investment aimed improving product quality, lowering costs of pr duction, altering market focus and orientatio and maintaining or upgrading capital equipmer In some cases, steps have been taken to alter cc porate structures, often through the creation partnerships (or joint ventures), in which th have relinquished a share of ownership. In ma cases, business practices and procedures are b ing revised in order to provide better service customers.

Current modernization efforts of the maj companies are wide ranging and, as a group, i volve virtually all areas of operations. Althou the major producers share fairly common go and strategies, differences in the condition their facilities, varying abilities to raise capit and divergent business philosophies have led variations in the breadth of each companies' ca tal investment programs.[193] Despite the individual differences, all major companies spe

[191] Appendix G contains firm specific reports on the efforts of the major integrated steel companies to adjus to competition and modernize their facilities.

[192] The companies included in this category by the USITC include Armco Steel Co., L.P. (ASC,LP), Bethlehem Steel Corp., Inland Steel Co., LTV Steel Co., National Steel Corp., Rouge Steel Co., the USS Div. of USX Corp., Weirton Steel Corp., and Wheelir Pittsburgh Steel Co.

[193] Relative annual expenditure levels are not necessarily indicative of long term investment plans. Certain short-term expenditures, such as a blast furnace reline may add to a single year's expenditures. Differences ir the timing of programs also contributes to variation.

Table 40

Executive compensation: Direct and indirect compensation for chief executive c ficers and other offi-ce·s at major steelmaking companies during 1989

	Direct compensation[1]		Indirect compensation[2]	Total	Avg. pe officer
	Salary	Other			
	$1,000 dollars				
Officers:					
Chief Executive Officer[3]	3,970	1,345	1,665	6,980	776
Other Officers	15,499	4,983	6,180	26,632	259
Total	19,469	6,328	7,84	33,612	300

[1] Direct compensation includes the amount of gross salary, including any amount of salary deferred for compa plans; other direct compensation includes any bonus awarded (including any amounts deferred to a subsequent year), including profit sharing and/or incentive compensation, and/or performance awards, and fees.

[2] Indirect compensation refers to forms of compensation which may be awarded to the employee such as con pany contributions made for stock, stock option and other stock plans, pension plans, thrift or investment plans, a all other benefits such as life, health, or legal insurance plans.

[3] The chief executive officer is defined as that employee of the company who has ultimate executive authority

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commissior

Table 41
Major steel companies: Capital expenditures and net sales, 1989

Company	1989 capital expenditures	Net sales	Expenditures as a percent of net sales
		($ millions)	($ billions)
Armco Steel Co., LP	(1)	(1)	[2]8.7
Bethlehem	421	5.3	7.9
Inland	141	2.4	5.9
LTV	356	4.1	8.7
National	250	2.6	9.6
Rouge	(1)	(1)	(1)
USS	365	5.7	6.4
Weirton	131	1.3	9.9
Wheeling-Pittsburgh	100	1.1	9.1
Total[3]	1,764	22.5	[4]8.2

[1] Not available.
[2] Estimated from segmented financial information reported in the 1989 annual report of Armco Inc.
[3] Total of available data.
[4] Average.

Source: Public reports issued by the respective companies.

sums equivalent to 6 to 10 percent of their net sales on capital investment in 1989, as shown in table 41. As a whole, the majors spent over $1.7 billion in 1989 to upgrade their steel facilities.

Certain areas being emphasized, especially facilities that produce flat-rolled products (table 42). The installation and upgrading of slab casters tht proceeded during 1989 at several firms (National, Weirton, ASCLP) will allow them to produce 100 percent of their output via the continuous casting method once these projects are complete.[194] The nine ladle metallurgy facilities

[194] At the completion of its caster modernization, Wheeling-Pittsburgh's production will reportedly be 97-percent continuously cast.

Table 42
Major steel companies: Modernization programs related to flat-rolled production in 1989

Company	Works	Ladle metallurgy facilities	Continuous casters	Hot Strip mills	Tandem mills
ASCLP	Ashland	—	Up-grade	—	Up-grade
	Middletown	New	—	Up-grade	Up-grade
		Up-grade[1]			
Bethlehem[2]	Burns Harbor	New[1]	Up-grade	—	—
	Sparrows Point	—	Up-grade	Up-grade	Up-grade
Inland	Indiana Harbor	New			
		Up-grade[1]	Up-grade	Up-grade	—
	I/N Tek[3]	—	—	—	New
LTV	Cleveland	New[1]	—	Up-grade	Up-grade
	Indiana Harbor	New[1]	Up-grade	Up-grade	Up-grade
National	Great Lakes	—	—	Up-grade	Up-grade
	Granite City	—	New	—	Up-grade
	Mid-west	—	—	—	Up-grade
Rouge	Dearborn	—	—	Up-grade	—
USS	Gary	New[1]	New	Up-grade	—
	Fairfield	—	—	Up-grade	Up-grade
	Mon Valley	—	New	—	—
Weirton	Weirton	Up-grade[1]	Up-grade	Up-grade	Up-grade
W-P	Steubenville	—	Up-grade	Up-grade	—
	Allenport	—	—	—	Up-grade

[1] Vacuum degassing facility
[2] Bethlehem also installed a new ladle refining station at its Johnstown bar plant.
[3] I/N Tek is a joint venture with Nippon Steel of Japan.

Source: "The U.S. and Canadian Steel Industry, 1989", *Iron Age*, February 1990.

will allow more efficient use of bulk steelmaking equipment while simultaneously producing steels with superior metallurgical properties. Efforts to improve the dimensional specifications of sheet products have produced widespread efforts to improve hot-strip and cold-reduction (tandem) mills.

The majority of investments aimed at modernization have product quality improvement as one, if not the primary, objective.[195] In many instances, significant improvements in product quality can come only through the investment in upgraded or new equipment. However, there are actions related to control of raw materials and processes that improve product quality, as well as customer service, without major capital investments. Common examples of this sort involve the major firms emphasizing tighter control over their operations through the use of statistical process control (SPC) and the implementation of electronic data interchange (EDI) systems.

SPC involves continuous monitoring of operating parameters and input characteristics. Averages and acceptable ranges of variation are established for such parameters that allow the companies to reduce the variability of their output. In many manufacturing applications, consistency of the product is as important as any other attribute of quality. Virtually all of the major companies have implemented SPC to some degree. For example, many producers of flat-rolled products for the auto industry have installed SPC systems to better meet increasingly exacting consumer requirements for steel gauge and dimension.

EDI ties the producers to major suppliers and customers and allows real time access to information concerning orders, prices, and production and shipping schedules. The level of implementation, and therefore the number of functions available, varies from firm to firm but all companies see this as an effective means of reducing the cost of sales and improving the level of service they can provide to their customers, as well as a valuable tool for monitoring their own operations.

While most of the industry's expenditures are for modernization of facilities, the nature of the integrated steel production process requires significant levels of expenditures for functions that can be characterized as either: (1) maintenance; or (2) ancillary plant and equipment not directly related to steel production. A primary example of required maintenance is blast furnace relines or rebuilds. These actions, which generally do not result in "modernization" in the common sense of the word, are necessary to keep the plant running and cost in the tens of millions of dollars. An example of expenditures on nonproductive facilities is pollution control equipment; the integrated process generates large waste streams that require significant investment to control. Interviews with major companies reveal that over the next few years, up to 40 percent of investment expenditures may be accounted for by these two types of expenditures.

As part of efforts to adjust to competitive conditions, many of the major companies are restructuring the ownership of facilities and/or the product line mix. There is a generally increasing emphasis on higher valued flat rolled products, in terms of research, investment, and marketing efforts. All major producers that produce non-flat-rolled products have made moves to isolate their flat-rolled operations from non-flat-rolled operations. Divisions have been sold off (LTV), restructured as a separate joint venture with Japanese partners (USS and Armco) or organized as stand-alone profit centers (Bethlehem, Inland).

[195] Many of the investments also yield positive effects on productivity and cost structures.

APPENDIX A
COPY OF LETTER TO CHAIRMAN ANNE BRUNSDALE FROM AMBASSADOR CARLA HILLS, UNITED STATES TRADE REPRESENTATIVE, REQUESTING AN INVESTIGATION

THE UNITED STATES TRADE REPRESENTATIVE
Executive Office of the President
Washington, D.C. 20506

The Honorable Anne Brunsdale
Chairman
United States International
Trade Commission
500 E Street, S.W.
Washington, D.C. 20436

Dear Madam Chairman:

On July 25, 1989, the President announced the establishment of the Steel Trade Liberalization Program. The program is designed to phase out in a responsible and orderly manner the voluntary restraint arrangements (VRAs) that have limited steel imports into the U.S. market for the past five years, and to negotiate an international consensus to remove unfair trade practices. In order to achieve this goal, the President has directed me to carry out implementation of the program.

To facilitate this policy, I request, pursuant to Section 332(g) of the Tariff Act of 1930, under authority delegated by the President, that the Commission monitor competitive conditions in the steel industry and the industry's efforts to adjust and modernize, including trends and developments in wages and investment, and prepare annual reports on these matters. To the extent possible, the report should include information on the major companies' compensation of executive officers, as well as information from domestic producers and purchasers regarding recent improvements in domestic quality and service, including those that result from industry modernization.

Also, under title VIII of the Trade and Tariff Act of 1984, as amended, the President is required to make an annual determination to the Congress regarding the adjustment efforts of the major steel companies. To assist in this determination, I request the Commission to include in its annual reports the best information it can compile for the preceding 12-month period ending September 30 of 1990 and 1991 on the following matters.

(A) The extent to which the major companies of the steel industry have, or will have committed their net cash flow from steel product operations for purposes of reinvestment in, and modernization of, that industry through investment in modern plant and equipment, research and development, and other

appropriate projects, such as working capital or steel operations and programs for the retraining of current and former workers;

(B) Actions taken by the major companies to maintain their international competitiveness, including actions to produce price-competitive and quality-competitive products, and to control costs of production, including employment costs, and to improve productivity; and

(C) Whether each of the major companies committed, or will have committed, not less than one percent of net cash flow to the retraining of current and former workers. This information on retraining should include a comparison of the amounts used to retrain displaced former employees and amounts used for on-the-job retraining within the industry.

If any major company did not commit at least one percent of its net cash flow to the retraining of workers, the Commission should report any unusual economic circumstances which contributed to the company's failure to do so.

For the purpose of this request, the terms "steel industry", "major company", and "net cash flow" shall have the same meaning as that set forth in title VIII of the Trade and Tariff Act of 1984, as amended.

Inasmuch as the President's determination called for in the Act will have to be made before the end of each annual period, the Commission is requested to submit its annual reports by August 1, 1990 and August 1, 1991.

In accordance with USTR policy, I direct you to mark as "confidential" such portions of the Commission's report and its working papers as my Office will identify in a classification guide. Information Security Oversight Office Directive No. 1, section 2001.21 (implementing Executive Order 12356, sections 2.1 and 2.2) requires that classification guides identify or categorize the elements of information that require protection. Accordingly, I request that you provide my Office with an outline of this report as soon as possible. Based on this outline and my Office's knowledge of the information to be covered in the report, a USTR official with original classification authority will provide detailed instructions.

Thank you for your cooperation in this matter.

Sincerely,

Carla A. Hills

CAH:pjm

APPENDIX B
NOTICE OF THE COMMISSION'S INVESTIGATION

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C. 20436

Investigation No. 332-289

Steel Industry: Annual Report on Competitive Conditions in the Industry and Industry Efforts to Adjust and Modernize

AGENCY: UNITED STATES INTERNATIONAL TRADE COMMISSION

ACTION: Institution of investigation.

SUMMARY AND BACKGROUND: The Commission instituted the investigation, No. 332-289, under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)) following receipt on February 28, 1990, of a request from the United States Trade Representative (USTR); the request was made at the direction of the President as part of the implementation of the Steel Trade Liberalization Program which extended voluntary restraint arrangements for a transitional period of two and one-half years to March 31, 1992.

In accordance with the request, the Commission will monitor competitive conditions in the steel industry and the industry's efforts to adjust and modernize, including trends and developments in wages and investment, and prepare annual reports on these matters. To the extent possible, the reports will include information on the major companies' compensation of executive officers, as well as information from domestic producers and purchasers regarding recent improvements in domestic quality and service, including those that result from industry modernization.

Under title VIII of the Trade and Tariff Act of 1984 (19 U.S.C. 2253 note), the President is required to make an annual determination to the Congress regarding the adjustment efforts of the major steel companies. To assist in this determination, the Commission has been requested to include in its annual reports the best information it can compile for the preceding 12-month period ending September 30 of 1990 and 1991 on the following matters.

(A) The extent to which the major companies of the steel industry have, or will have committed their net cash flow from steel product operations for purposes of reinvestment in, and modernization of, that industry through investment in modern plant and equipment, research and development, and other appropriate projects, such as working capital for steel operations and programs for the retraining of current and former workers;

(B) Actions taken by major companies to maintain their international competitiveness, including actions to produce price-competitive and quality-competitive products, and to control costs of production, including employment costs, and to improve productivity; and

(C) Whether each of the major companies committed, or will have committed, not less than one percent of net cash flow to the retraining of current and former workers. This information on retraining should, include a comparison of the amounts used to retrain displaced former employees and amounts used for on-the-job retraining within the industry

any major company did not commit at least one percent of its net cash flow the retraining of workers, the Commission has been asked to report any usual economic circumstances which contributed to the company's failure to so.

r the purpose of this investigation, the terms "steel industry", "major mpany", and "net cash flow" have the same meaning as that set forth in title II of the Trade and Tariff Act of 1984.

asmuch as the President's determination called for in the Act will have to made before the end of each annual period, the Commission has been quested to submit its annual reports by August 1, 1990 and August 1, 1991.

FECTIVE DATE: March 16, 1990

)R FURTHER INFORMATION CONTACT: Mr. Mark Paulson, Minerals and Metals .vision, United States International Trade Commission, 500 E Street SW., shington, D.C. 20436 (telephone: 202-252-1432).

ITTEN SUBMISSIONS: Interested persons are invited to submit written atements concerning the investigation. Commercial or financial information ich a submitting party desires the Commission to treat as confidential must submitted on separate sheets of paper, each clearly marked as "Confidential siness Information" at the top. All submissions requesting confidential eatment must conform with the requirements of section 201.6 of the mmission's Rules of Practice and Procedures (19 CFR 201.6). All written bmissions, except for confidential business information, will be made ailable for inspection by interested persons. To be assured of consideration the Commission, written statements should be received at the earliest date, t not later than July 1, 1990 and by July 1, 1991. All submissions should addressed to the Secretary, United States International Trade Commission, 0 E Street SW., Washington, D.C. 20436. Hearing-impaired individuals are ivised that information on this matter can be obtained by contacting our TDD rminal on (202) 252-1809.

order of the Commission.

Kenneth R. Mason
Secretary

ssued: March 16, 1990

APPENDIX C
DEFINITION OF CERTAIN TERMS AND DESCRIPTION OF THE PRODUCTS SUBJECT TO THE INVESTIGATION

DEFINITIONS

1. *Firm.*—An individual proprietorship, partnership, joint venture, association, corporation (including all divisions, any subsidiary corporations, and parent corporations), business trust, cooperative, trustees in bankruptcy, or receivers under decree of any court, owning or controlling one or more establishments, as defined below.

2. *Establishment.*—Each plant of a firm in the United States in which carbon and/or alloy steel products (as defined below) are produced and all auxiliary facilities operated in conjunction with (whether or not physically separate from) such production facilities, e.g., warehouses, shipping facilities, and the like.

3. *Steel industry.*—Producers in the United States of steel products.

4. *Net cash flow.*—Annual net (aftertax) income plus depreciation, depletion allowances, amortization, and changes in reserves minus dividends and payments on short-term and long-term debts and liabilities.

5. *United States.*—The 50 States, Puerto Rico, and the District of Columbia.

6. *Steel.*—An alloy of iron and carbon that is malleable as first cast. Steel may contain other elements, but iron must predominate, by weight, over each of the other elements.

7. *Carbon steel.*—Steel in which none of the elements listed below exceeds the quantity, by weight, respectively indicated:

   1.65 percent of manganese, or
   0.25 percent of phosphorus, or
   0.35 percent of sulphur, or
   0.60 percent of silicon, or
   0.60 percent of copper, or
   0.30 percent of aluminum, or
   0.20 percent of chromium, or
   0.30 percent of cobalt, or
   0.35 percent of lead, or
   0.50 percent of nickel, or
   0.30 percent of tungsten, or
   0.10 percent of any other metallic element.

8. *Alloy steel.*—Steel which contains any of the elements listed in definition 7 (above) in excess of its specified quantity.

   (i) Stainless steel.—Any alloy steel which contains by weight 1.2 percent or less of carbon and 10.5 percent or more of chromium;

   (ii) Tool steel.—Alloy steel which contains the following combinations of elements in the quantity, by weight, respectively indicated:

   (A) more than 1.2 percent carbon and more than 10.5-percent chromium; or

   (B) not less than 0.85 percent carbon and 1.0-percent to 1.8-percent, inclusive, manganese; or

   (C) 0.9-percent to 1.2-percent, inclusive, chromium and 0.9-percent to 1.4-percent, inclusive, molybdenum; or

   (D) not less than 0.5-percent carbon and not less than 3.5-percent molybdenum; or

   (E) not less than 0.5-percent carbon and not less than 5.5-percent tungsten; or

   (F) not less than 0.3-percent carbon and 1.25-percent or more but less than 10.5-percent chromium.

   (iii) Certain alloy steel.—Alloy steel not covered under 8.(i) "Stainless steel" or 8.(ii) "Tool Steel."

9. Galvanized.—Steel that has been coated or plated with zinc.

10. *Hot-rolled.*—Steel that has been reduced to its final thickness by heating and rolling the product at elevated temperature (usually above 2,200° F).

11. *Cold-rolled.*—Steel that has been reduced to its final thickness by rolling the product without heating it immediately prior to the rolling operation.

12. *Continuous casting.*—The method of producing semifinished products in which molten steel flows evenly into a caster where it is rapidly cooled, causing it to solidify directly into semifinished products such as slabs and billets.

13. *Short ton.*—Two thousand (2,000) pounds.

14. *Semifinished products include.*—Continuous cast products of solid section, not presented in coils, whether or not subjected to primary hot-rolling—other products of solid section which have not been further worked than subjected to primary hot-rolling or roughly shaped by forging, including blanks for angles, shapes, or sections.

Ingots.—Castings resulting from the solidification of molten steel and having a columnar form suitable for working by rolling or forging. Ingots are included in AISI (American Iron and Steel Institute) product group No. 1A.

Blooms, billets, slabs, and sheet bars.—Other products of solid cross section, which have not been further worked than subjected to primary hot-rolling or roughly shaped by forging including blanks for angles, shapes or sections. These products are not presented in coils and are included in AISI product group No. 1B.

For the purpose of this report, flat-rolled products are classified as follows:

15. *Flat-rolled products.*—Rolled products of solid rectangular (other than square) cross section, whether perforated, corrugated, polished, or with a pattern derived from rolling, which do not conform to the definition of semifinished products above in the form of:

coils of successively superimposed layers, or

straight lengths, which if of a thickness less than 0.187 inches (4.75 mm) are of a width measuring at least 10 times the thickness or if of a thickness of 0.187 inches (4.75 mm) or more are of a width that exceeds 5.9 inches (150 mm) and measures at least twice the thickness. Also those products of a shape other than rectangular, or, square of a width of 23.6 inches (600 mm) or more, not elsewhere specified.

(i) *Plates.*—Flat-rolled products whether or not corrugated or crimped, in coils or cut to length. Plates are 0.188 inches (4.7625mm) or more in thickness and, if not cold rolled, over 8 inches (20.32 cm) in width, or if cold rolled, over 12 inches (30.45 cm) in width. Plates are included in AISI product group No. 6.

(ii) *Sheets and strip.*—Flat-rolled products whether or not corrugated or crimped, in coils or cut to length. Sheet is less than 0.188 inches (4.7625 mm) in thickness and over 12 inches (30.48 cm) in width. Strip is less than 0.188 inches (4.7625 mm) in thickness, not over 12 inches (30.48 cm) in width and, if cold-rolled, over 0.5 inches (1.27 cm) in width. Sheets and strip are included in AISI product group Nos. 28, 29, 29A, 30, 31, 32, 33A, 33B, 34, 34B, 35, 36, and 37.

16. *Bars.*— Hot-rolled products whether or not in irregularly wound coils, which have a solid cross section along their length in the shape of circles, segments of circles, ovals, rectangles (including squares), triangles, or other convex polygons. Such products may have indentations, rubs, grooves or other deformations produced during the rolling process (reinforcing bars and rods); be twisted after rolling.

For purposes of this investigation the term "bars" also includes hollow drill steel, which is a hollow product suitable for making mining drills or mining drill rods, of which the greatest external dimension of the cross-section exceeds 0.6 inches (15 mm) but does not exceed one-half of the greatest external dimension. Bars and hollow drill steel are found in AISI product groups Nos. 14, 14A, 15, and 16.

For the purposes of this investigation, bars and light structural shapes are classified as follows:

(i) *Hot-rolled bars,* including light structural shapes, (which are bar-size light shapes having a cross-sectional dimension of less than 3 inches (7.62 cm) included in AISI product group 14A) and reinforcing bars. Hot-rolled carbon and alloy bars are included in AISI product group Nos. 14 and 15.

(ii) *Cold-formed bars,* included in AISI product group No. 16.

17. *Wire rods.*—Coiled, semifinished, hot-rolled products of solid cross section, approximately round in cross section, not under 0.219 inches (5.5 mm) nor over 0.75 inches (19 mm) in diameter. Wire rods are included in AISI product group No. 3.

18. *Wire and wire products*

(i) Wire includes cold-formed products in coils, of any uniform solid cross section along their whole length, which do not conform to the definition of flat-rolled products. Steel wire is included in AISI product group No. 23.

(ii) Wire products are defined as follows:

(A) *Nails and brads, spikes, staples, and tacks* are fasteners of one piece construction, made of round wire, and not including thumb tacks, staples in strip form, corrugated fasteners, glaziers' points, hook nails, ring nails, or fasteners suitable for use in power-actuated hand tools. Nails and staples are included in AISI product group No. 51.

(B) *Barbed wire* is a wire, or strand of twisted wires, armed with barbs or sharp points. Barbed wire is included in AISI product group No. 52.

(C) *Wire expanded metal, grill and fencing* include products, whether or not galvanized, wholly of round wire with a maximum cross-sectional diameter of 0.12 inches (3 mm) or more, having a mesh size of 39.4 cubic inches (100 cm3) or more, whether or not such wire is covered with plastics. The products are included in AISI product group No. 50.

(D) *Baling wire and ties,* with or without buckles or fastenings and whether or not coated with paint or other substance and included in AISI product group No. 53.

(E) *Wire strand* is two or more wires that together constitute one of the parts which are twisted together to form rope, cord, or cordage, suitable for fencing purposes, not fitted with fittings, not made up into articles, not of brass-plated wire, not covered with nonmetallic material. Wire strand is included in AISI product group No. 45.

(F) *Wire ropes, cables, and cordage* are products made by the twisting of a number of wire strands and are not covered with nonmetallic material, not fitted with fittings, not made up into articles, and, if valued 13 cents or more per pound, not of brass-plated wire. Wire ropes, cables, and cordage are included in AISI product group No. 47.

(G) *Milliners wire* is wire covered with textile or other material not wholly of metal. Milliners wire is included in AISI product group No. 23(pt.).

19. *Structurals.*—Rolled flanged sections, sections welded from plates and special sections including beams, channels, tees, zees and angles with a cross section of 3 inches or more.

(i) *Heavy structural shapes* having a maximum cross-sectional dimension of 3 inches (7.62 cm) or more, and sheet piling.

(ii) *Fabricated structural units,* which include columns, pillars, posts, beams, girders, and similar structural units. These products are included in AISI product group Nos. 38 and 39.

20. *Rails and related railway products* as defined by the following:

(i) *Rails* are hot-rolled steel products, whether punched or not punched, weighing not less than 8 pounds per yard, with cross-sectional shapes intended for carrying wheel loads in railroad, railway, and crane runway applications. Rails are included in AISI product group Nos. 7, 8 and 41.

(ii) *Joint bars* are hot-rolled steel products, usually punched or slotted, designed to connect the ends of adjacent rails in track; *tie plates* are hot-rolled steel products that are punched to provide holes for spikes and have one or two shoulder sections as rail guides and are used to support rails in track, to maintain track gauge, and protect the ties. Joint bars and tie plates are included in AISI product group Nos. 9 and 42 (pt.).

(iii) *Railway track spikes,* of one piece construction, used to secure tie plates or ties. Railway track spikes are included in AISI product group No. 42 (pt.).

(iv) *Railroad and railway (RR) axles and wheels, parts thereof, and axle bars.* These articles are included in AISI product group No. 43.

21. Pipes and tubes and blanks therefor.—Tubular products, including hollow bars and hollow billets but not including hollow drill steel, of any cross-sectional configuration, by whatever process made, whether seamless, brazed, or welded and whether with an open or lock seam or joint. For the purposes of this investigation, pipes and tubes and blanks therefor are classified as follows:

(i) *Oil country tubular goods.* Oil country tubular goods are included in AISI product group No. 19.

(ii) *Line pipe.* Line pipe is included in AISI product group No. 20.

(iii) *Mechanical pipe.* Mechanical pipe is included in AISI product group No. 21A.

(iv) *Structural pipe.* Structural pipe is included in AISI product group No. 22.

(v) *Pressure tubing.* Pressure tubing is included in AISI product group No. 21B.

(vi) *Stainless steel pipes and tubes.* Stainless steel pipes and tubes are included in AISI product group Nos. 21C and D.

(vii) *Other, including standard.* Other, including standard pipe, is included in AISI product group No. 18.

APPENDIX D
STATISTICAL TABLES FOR THE DOMESTIC INDUSTRY, 1989 AND JANUARY-MARCH 1990

Table D-1
Steel: Producers' purchases and shipments of mill products, by quantity and value, 1989

Product	Purchases		Shipments		
	Domestic	Foreign[1]	Net	Total	Value
		(1,000 short tons)			(1,000 dollars
Carbon and certain alloy steel:[2]					
Ingots, blooms, billets, slabs and sheet bars	2,253	1,884	1,871	6,008	1,360,239
Sheets and strip	3,508	573	40,921	45,001	22,728,879
Plate	94	71	5,424	5,589	2,781,253
Bars	743	78	11,847	12,668	6,483,394
Structural shapes and units	8	1	6,357	6,366	2,537,799
Rails and related railway products[3]	361	11	289	661	351,686
Wire rod	818	225	3,110	4,184	1,469,556
Wire and wire products	8	2	2,214	2,224	1,520,804
Pipe and tube	109	35	4,646	4,790	3,576,733
Subtotal, carbon and certain alloy[4]	7,901	2,907	76,922	87,730	42,997,714
Stainless and alloy tool steel:					
Ingots, blooms, billets, slabs, and sheet bars	84	26	54	165	321,365
Sheet and strip	113	2	858	973	2,454,220
Plate	1	0	203	204	667,613
Bars and shapes	(5)	2	412	414	862,403
Wire rod	7	4	28	39	132,035
Wire	2	0	33	35	169,519
Pipes and tubes	(5)	0	21	21	117,893
Subtotal, stainless and alloy tool steel4	207	34	1,609	1,851	4,725,048
Grand total[4]	8,108	2,941	78,531	89,581	47,722,762

[1] Includes purchases from unknown sources, which accounted for 62,000 tons.
[2] Certain alloy refers to alloy steel other than stainless or tool steel.
[3] Includes rails purchased for rerolling into other shapes.
[4] Totals may not add due to rounding.
[5] Less than 1,000.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table D-2
Certain steel products: Annual steel purchases by questionnaire respondents, by product and grade o steel, 1989

Product	Purchases	
	Quantity	Value
	(short tons)	($1,000)
Carbon and certain alloy steel:		
Semifinished	287,249	960,056
Sheets and strip	1,649,297	888,517
Plate	17,109,363	10,216,693
Bars and light shapes	2,136,010	1,242,810
Structurals	930,613	871,366
Rails and railway products	798,934	414,349
Wire rod	102,748	59,810
Wire and wire products	96,145	271,249
Pipe and tube	790,082	803,580
Total	23,900,441	15,728,430
Stainless and alloy tool steel:		
Semifinished	9,891	12,886
Sheet and strip	306,972	725,724
Plate	46,163	158,076
Bars and shapes	55,343	196,234
Wire rod	3,187	6,788
Wire and wire products	13,990	29,175
Pipe and tube	18,613	126,843
Total	454,159	1,255,726
All grades of steel:		
Total	24,354,600	16,984,156

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table D-3
Steel: U.S. producers' reported capacity and production, 1989, and capacity utilization, 1989 and 1990

Item	Capacity	Production	Capacity Utilization	
			1989	1990
	1,000 tons		Percent	
Certain carbon and alloy steel:				
Cokemaking	27,942	24,917	89	89
Ironmaking	65,944	53,671	81	79
Steelmaking				
Basic oxygen process	67,318	58,779	87	87
Electric furnace	41,944	33,307	79	79
Open hearth process	7,345	4,442	60	46
Products:				
Sheets and strip				
Hot-rolled	65,697	51,876	79	77
Cold-rolled	40,138	30,504	76	74
Galvanized	12,030	11,064	92	84
Other coated	7,402	5,226	71	65
Plates	7,739	5,031	65	65
Bars and light structurals				
Hot-finished	20,335	15,646	77	75
Cold-finished	1,604	1,172	73	73
Medium and heavy structurals[1]	7,051	4,954	70	80
Pipes and tubes				
Seamless pipes	2,769	1,716	62	64
Welded pipes	6,895	3,466	50	53
Other pipe and tube	1,502	818	54	54
Rails and rail products	1,155	555	48	52
Wire rods	6,295	4,583	73	75
Wire	2,943	2,105	72	68
Wire products	1,599	1,034	65	69
Stainless and alloy tool steel:				
Electric furnace	2,512	1,862	74	61
Products:				
Sheets and strip				
Hot-rolled	941	732	78	80
Cold-rolled	928	692	75	64
Plates	286	228	80	88
Bars and light structurals				
Hot-finished	243	166	68	64
Cold-finished	227	150	66	61
Pipes and tubes	32	19	59	51
Wire rods	79	40	51	40
Wire	59	41	69	83

[1] Structural shapes with a cross section exceeding 3 inches.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table D-4
Financial experience of U.S. steel producers and converters,[1] 1989

(1,000 dollars)

Item	*Integrated*	*Minimills*	*Specialty*	*Processor*
Net sales:				
Excluding intracompany and intercompany transfers	27,840,909	9,599,277	4,712,454	6,255,501
Intracompany and inter-company transfers	1,816,846	664,248	189,108	347,787
Total net sales	29,657,755	10,263,525	4,901,562	6,603,288
Cost of goods sold (including intra-company and inter-company transfers):				
Raw materials	6,151,275	3,320,759	1,667,493	3,736,907
Direct labor	4,087,589	1,006,213	581,472	392,140
Other factory costs, including depreciation and amortization	6,890,491	2,901,952	1,119,589	1,025,064
Total cost of goods sold[2]	26,561,612	8,963,806	4,058,659	5,782,207
Gross profit or (loss)	3,096,143	1,299,719	842,903	821,081
General, selling, and administrative expenses	1,154,430	527,450	250,068	482,195
Net operating profit or (loss)	1,941,713	772,269	592,835	338,887
Other income or (expense):				
Net interest income or expense	(152,585)	(225,139)	(37,654)	(120,324
All other income or (expense)[3]	(71,267)	(33,726)	(32,451)	19,607
Total other income or (expense)[4]	(223,852)	(258,865)	(70,105)	100,723
Net profit or (loss) before taxes	1,717,861	513,404	522,730	238,159
Depreciation and amortization	1,147,123	426,587	84,552	140,805

[1] Certain respondents included financial information on related products.
[2] Including nonitemized costs.
[3] Certain respondents reported extraordinary and non-recurring expenses.
[4] Including itemized expenses.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

able D-5
teel products covered by the Voluntary Restraint Agreements: U.S. imports by product and grade of teel, 1984-89, and Jan.-Apr., 1989-90

	1984	1985	1986	1987	1988	1989	January-April 1989	January-April 1990
	(1,000 tons)							
arbon and certain alloy:								
Semifished	1,618	2,430	2,067	2,233	2,783	2,136	683	739
Plate	1,775	1,761	1,440	1,556	1,857	1,419	466	353
Sheet and strip	10,194	8,910	8,127	7,747	7,185	6,303	1,897	1,744
Bars & certain shapes	1,652	1,475	1,394	1,281	1,361	1,264	455	299
Wire rod	1,571	1,456	1,344	1,449	1,475	1,128	368	367
Wire	649	590	564	537	520	473	167	150
Wire products	739	675	637	649	572	704	224	246
Structural shapes and units	2,433	2,440	2,180	2,154	2,188	1,640	643	312
Rails & related products	374	382	276	246	319	323	131	95
Pipe & tube	5,400	4,457	2,923	2,747	3,250	2,436	805	828
Total	26,404	24,578	20,952	20,599	21,510	17,826	5,840	5,132
tainless and alloy tool steel:								
Semifished	14	10	18	57	62	62	25	16
Plate	7	11	16	11	16	18	7	7
Sheet and strip	138	136	152	129	119	141	42	43
Bars & certain shapes	38	38	38	38	41	43	13	14
Wire rod	19	20	18	18	19	22	7	7
Wire	23	22	18	19	21	21	8	6
Pipe & tube	30	32	33	26	37	37	14	17
Tool steel	32	37	45	41	44	48	18	13
Total	300	307	338	340	359	393	134	123
ll grades of steel								
Total	26,705	24,885	21,289	20,938	21,869	18,219	5,974	5,256
	(Percent)							
arbon and certain alloy:								
Semifished	6.0	9.7	9.7	10.7	12.7	11.7	11.4	14.1
Plate	6.6	7.1	6.8	7.4	8.5	7.8	7.8	6.7
Sheet and strip	38.2	35.8	38.2	37.0	32.9	34.6	31.8	33.2
Bars & certain shapes	6.2	5.9	6.5	6.1	6.2	6.9	7.6	5.7
Wire rod	5.9	5.9	6.1	6.9	6.7	6.2	6.2	7.0
Wire	2.4	2.4	2.6	2.6	2.4	2.6	2.8	2.9
Wire products	2.8	2.7	3.0	3.1	2.6	3.9	3.7	4.6
Structural shapes and units	9.1	9.8	10.2	10.3	10.0	9.0	10.8	5.9
Rails & related products	1.4	1.5	1.3	1.2	1.5	1.8	2.2	1.8
Pipe & tube	20.2	17.9	13.7	13.1	14.9	13.4	13.5	15.8
Total	98.9	98.8	98.4	98.4	98.4	97.8	97.8	97.6
tainless and alloy tool steel:								
Semifished	0.1	(1)	0.1	0.3	0.3	0.3	0.4	0.3
Plate	(1)	(1)	0.1	0.1	0.1	0.1	0.1	0.1
Sheet and strip	0.5	0.5	0.6	0.6	0.5	0.8	0.7	0.8
Bars & certain shapes	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3
Wire rod	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Wire	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Pipe & tube	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.3
Tool steel	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.2
Total	1.1	1.2	1.6	1.6	1.6	2.2	2.2	2.3
ll grades of steel								
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Less than 0.05 percent.

lote.—Due to rounding, figures may not add up to totals shown.

Source: U.S. International Trade Commission, Monthly Report on the Status of the Steel Industry, USITC Publication 2262, March 1990.

Table D-6
Selected steel mill products: U.S. exports, 1984-89

Product category	1984	1985	1986	1987	1988	1989	Chang 1988-8
				(1,000 tons)			
All grades of steel:							
Semifinished	74	90	59	74	61	391	330
Plate	88	83	70	85	119	631	512
Sheet and strip	390	375	507	570	1374	2608	1234
Hot-rolled sheet	52	57	76	104	419	1156	737
Cold-rolled sheet[1]	78	67	99	103	205	499	294
Galvanized sheet & strip	32	29	27	58	267	444	177
Tin mill products[1]	123	131	209	163	292	218	-74
Other	105	91	96	142	191	291	100
Pipe and tube	207	199	121	152	250	443	193
OCTG	53	62	36	30	95	320	225
Other	154	137	85	122	155	123	-32
Other	221	185	170	248	265	505	240
Total	980	932	929	1129	2069	4578	2509
				(Percent)			
All grades of steel:							
Semifinished	8	10	7	7	3	9	6
Plate	9	9	8	8	6	14	8
Sheet and strip	40	40	55	50	66	57	-9
Hot-rolled sheet	5	6	8	9	20	25	5
Cold-rolled sheet[1]	8	7	11	9	10	11	1
Galvanized sheet & strip	3	3	3	5	13	10	-3
Tin mill products[1]	13	14	22	14	14	5	-9
Other	11	10	10	13	9	6	-3
Pipe and tube	21	21	13	13	12	10	-2
OCTG	5	7	4	3	5	7	2
Other	16	15	9	11	7	3	-5
Other	23	20	18	22	13	11	-2
Total	100	100	100	100	100	100	0.0

[1] Despite recent changes in the industry's categorization of black plate, exports of black plate have been categorized under cold-rolled sheet (instead of tin mill products) for each of the years shown in order to maintain statistical continuity.

Source: Data compiled from official statistics of the U.S. Department of Commerce, as published by the Americ Iron and Steel Institute

Table D-7
Sheet and strip: Prices changes relative to end of 4th quarter 1988, by quarter, as reported by purchasers, 1st quarter 1989 to 1st quarter 1990

Price change (P)	1989 End of 1st quarter	1989 End of 2d quarter	1989 End of 3d quarter	1989 End of 4th quarter	1990 End of 1st quarter
	(Percent of respondent)				
-12.5% ≥ P	2	2	2	2	2
- 7.5% ≥ P > -12.5%	1	4	3	3	4
- 2.5% ≥ P > -7.5%	17	26	28	28	24
2.5% ≥ P > -2.5%	75	59	50	50	36
7.5% ≥ P > 2.5%	3	8	12	12	17
12.5% ≥ P > 7.5%	1	2	5	5	9
P > 12.5%	0	0	1	1	8

Survey sample:
Number of respondents: 179
Number of price series: [1] 343

Note.-Due to rounding, percentages may not add to 100.

[1] A number of respondents provided data on more than one product. Moreover, certain respondents provided separate data on spot and contract proces; data sets on spot and contract prices were included where they represented more than 15 percent of a company's purchases.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table D-8
Plate and structurals: Prices changes relative to end of 4th quarter 1988, by quarter, as reported by purchasers, 1st quarter 1989 to 1st quarter 1990

Price change (P)	1989 End of 1st quarter	1989 End of 2d quarter	1989 End of 3d quarter	1989 End of 4th quarter	1990 End of 1st quarter
	(Percent of respondent)				
-12.5% ≥ P	1	1	1	1	2
- 7.5% ≥ P > -12.5%	1	2	3	5	3
- 2.5% ≥ P > -7.5%	15	20	20	17	14
2.5% ≥ P > -2.5%	75	64	55	38	32
7.5% ≥ P > 2.5%	6	10	11	22	20
12.5% ≥ P > 7.5%	2	2	7	12	17
P > 12.5%	1	2	3	6	11

Survey sample:
Number of respondents: 82
Number of price series: [1] 177

Note.-Due to rounding, percentages may not add to 100.

[1] A number of respondents provided data on more than one product. Moreover, certain respondents provided separate data on spot and contract proces; data sets on spot and contract prices were included where they represented more than 15 percent of a company's purchases.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table D-9
Bars: Prices changes relative to end of 4th quarter 1988, by quarter, as reported by purchasers, 1st quarter 1989 to 1st quarter 1990

Price change (P)	1989				1990
	End of 1st quarter	End of 2d quarter	End of 3d quarter	End of 4th quarter	End of 1st quarter
	(Percent of respondent)				
-12.5% ≥ P	1	2	3	4	3
-7.5% ≥ P > -12.5%	3	4	4	3	3
-2.5% ≥ P > -7.5%	19	21	21	20	21
2.5% ≥ P > -2.5%	70	60	53	44	34
7.5% ≥ P > 2.5%	5	7	12	16	18
12.5% ≥ P > 7.5%	1	4	4	9	13
P > 12.5%	0	1	3	3	6

Survey sample:
Number of respondents: 105
Number of price series:[1] 203

Note.-Due to rounding, percentages may not add to 100.

[1] A number of respondents provided data on more than one product. Moreover, certain respondents provided separate data on spot and contract process; data sets on spot and contract prices were included where they represented more than 15 percent of a company's purchases.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table D-10
Wire and wire rod: Prices changes relative to end of 4th quarter 1988, by quarter, as reported by purchasers, 1st quarter 1989 to 1st quarter 1990

Price change (P)	1989				1990
	End of 1st quarter	End of 2d quarter	End of 3d quarter	End of 4th quarter	End of 1st quarter
	(Percent of respondent)				
-12.5% ≥ P	1	1	1	1	3
-7.5% ≥ P > -12.5%	0	4	7	8	6
-2.5% ≥ P > -7.5%	11	21	25	26	18
2.5% ≥ P > -2.5%	79	69	60	51	51
7.5% ≥ P > 2.5%	8	3	4	9	16
12.5% ≥ P > 7.5%	1	1	2	5	4
P > 12.5%	0	1	1	0	1

Survey sample:
Number of respondents: 68
Number of price series:[1] 101

Note.-Due to rounding, percentages may not add to 100.

[1] A number of respondents provided data on more than one product. Moreover, certain respondents provided separate data on spot and contract process; data sets on spot and contract prices were included where they represented more than 15 percent of a company's purchases.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

able D-11
ipe and tube: Prices changes relative to end of 4th quarter 1988, by quarter, as reported by urchasers, 1st quarter 1989 to 1st quarter 1990

Price change (P)	1989 End of 1st quarter	1989 End of 2d quarter	1989 End of 3d quarter	1989 End of 4th quarter	1990 End of 1st quarter
	(Percent of respondent)				
12.5% ≤ P	1	1	2	1	1
- 7.5% ≤ P > -12.5%	2	3	5	5	7
- 2.5% ≤ P > -7.5%	11	22	25	25	25
2.5% ≤ P > -2.5%	79	66	56	50	30
7.5% ≤ P > 2.5%	7	4	9	13	17
12.5% ≤ P > 7.5%	1	3	3	3	7
P > 12.5%	0	0	1	3	5

Survey sample:
Number of respondents: 84
Number of price series:[1] 149

lote.-Due to rounding, percentages may not add to 100.

[1] A number of respondents provided data on more than one product. Moreover, certain respondents provided eparate data on spot and contract proces; data sets on spot and contract prices were included where they epresented more than 15 percent of a company's purchases.

ource: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

able D-12
tainless: Prices changes relative to end of 4th quarter 1988, by quarter, as reported by purchasers, 1st uarter 1989 to 1st quarter 1990

Price change (P)	1989 End of 1st quarter	1989 End of 2d quarter	1989 End of 3d quarter	1989 End of 4th quarter	1990 End of 1st quarter
	(Percent of respondent)				
-12.5% ≤ P	20	7	6	6	5
- 7.5% ≤ P > -12.5%	12	19	9	1	0
- 2.5% ≤ P > -7.5%	15	25	13	18	17
2.5% ≤ P > -2.5%	50	43	43	34	27
7.5% ≤ P > 2.5%	3	4	19	18	20
12.5% ≤ P > 7.5%	0	1	7	12	15
P > 12.5%	0	0	3	10	17

Survey sample:
Number of respondents: 83
Number of price series:[1] 157

lote.-Due to rounding, percentages may not add to 100.

[1] A number of respondents provided data on more than one product. Moreover, certain respondents provided eparate data on spot and contract proces; data sets on spot and contract prices were included where they epresented more than 15 percent of a company's purchases.

ource: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table D-13
Carbon and certain alloy steel: U.S. producers' and converters' capital expenditures, 1989

Value (1,000 dollars)

Item	Land and land improvement	Plant and equipment[1] [2]	Other	Total
Cokemaking facilities	***	116,479	***	123,
Ironmaking facilities	***	225,572	***	227,
Raw steelmaking facilities:				
Basic oxygen process	***	162,305	***	164,
Electric furnace	547	211,425	2,319	214,
Open hearth process	0	9,555	0	9,
Casting	***	90,431	***	90,
Secondary steelmaking facilities[3]	0	89,709	0	89,
Flat-rolled products:				
Plate mills	***	50,986	***	51,
Sheets and strip:				
Hot-strip mills	***	459,669	***	463,
Cold-rolled sheet mills	3,473	629,193	40,786	673,
Galvanizing facilities	***	72,105	***	72
Other coating facilities	0	79,663	0	79
Bar and light structural mills:				
Hot-finished	***	125,307	***	129
Cold-finished	***	31,962	***	32
Medium and heavy structural mills[4]	***	103,924	***	104
Rail mills	0	1,063	0	1
Wire rod mills	***	24,508	***	24
Wire-drawing machines	***	14,314	***	15
Wire products	***	11,404	***	13
Pipes and tubes:				
Seamless pipe mills	***	52,257	***	52
Welded pipe mills	***	74,435	***	75
Other pipe and tube mills	***	14,243	***	15
Other[5]	10,254	281,643	17,311	309
Total	24,095	2,932,152	77,890	3,034

[1] Includes expenditures for the specific type of facility as well as related facilities.
[2] Includes expenditures for pollution control and occupational safety and health (OSH) requirements.
[3] Includes ladle treatment (heat balance, alloy addition, degassing, decarburization, etc.) and other (vacuum remelt, electroslag remelting, etc.) secondary refining processes.
[4] Structural shapes with a cross section exceeding 3 inches.
[5] Includes expenditures which companies could not allocate to product groups.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commissic

Table D-14
Stainless and alloy tool steel: U.S. producers' and converters' capital expenditures, 1989

Value (1,000 dollars)

Item	Land and land improvement	Plant and equipment[1] [2]	Other	Tota
Raw steelmaking facilities:				
Electric furnace	***	34,194	***	34
Secondary steelmaking facilities[3]	***	368	***	
Flat-rolled products:				
Plate mills	***	7,587	***	7
Sheets and strip:				
Hot-strip mills	***	32,905	***	32
Cold-rolled sheet mills	***	23,093	***	23
Bars and shapes:				
Hot-finished	***	5,361	***	5
Cold-finished	***	5,934	***	6
Wire rod mills	***	741	***	
Wire-drawing machines	***	3,357	***	3
Pipes and tubes:				
Seamless pipe mills	***	345	***	
Welded pipe mills	***	1,357	***	1
Other pipe and tube mills	***	***	***	
Other[4]	***	***	***	
Total	752	124,151	1,358	126

[1] Includes expenditures for the specific type of facility as well as related facilities.
[2] Includes expenditures for pollution control and occupational safety and health (OSH).
[3] Includes ladle treatment (heat balance, alloy addition, degassing, decarburization, etc.) and other (vacuum remelt, electroslag remelting, etc.) secondary refining processes.
[4] Includes expenditures which companies could not allocate to product groups.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commissic

Table D-15
Carbon and certain alloy steel: U.S. producers' and converters' capital expenditures, Jan. 1, 1990-Mar. 31, 1990

Value (1,000 dollars)

Item	Land and land improvement	Plant and equipment[1] [2]	Other	Total
Cokemaking facilities	***	21,761	***	21,998
Ironmaking facilities	***	60,593	***	62,185
Raw steelmaking facilities:				
Basic oxygen process	***	21,279	***	23,372
Electric furnace	***	50,788	***	50,978
Open hearth process	***	***	***	***
Casting	***	21,266	***	21,266
Secondary steelmaking facilities[3]	***	90,441	***	90,441
Flat-rolled products:				
Plate mills	***	6,994	***	6,996
Sheets and strip:				
Hot-strip mills	***	116,796	***	119,623
Cold-rolled sheet mills	***	112,262	***	116,786
Galvanizing facilities	***	27,565	***	27,802
Other coating facilities	***	12,826	***	12,826
Bar and light structural mills:				
Hot-finished	***	32,376	***	33,778
Cold-finished	***	3,392	***	3,558
Medium and heavy structural mills[4]	***	21,177	***	21,387
Rail mills	***	***	***	***
Wire rod mills	***	***	***	***
Wire-drawing machines	***	6,718	***	7,006
Wire products	***	2,100	***	2,676
Pipes and tubes:				
Seamless pipe mills	***	4,376	***	4,431
Welded pipe mills	***	13,303	***	13,566
Other pipe and tube mills	***	6,188	***	6,311
Other[5]	***	***	***	***
Total	2,356	683,870	17,158	703,384

[1] Includes expenditures for the specific type of facility as well as related facilities.
[2] Includes expenditures for pollution control and occupational safety and health (OSH) requirements.
[3] Includes ladle treatment (heat balance, alloy addition, degassing, decarburization, etc.) and other (vacuum arc remelt, electroslag remelting, etc.) secondary refining processes.
[4] Structural shapes with a cross section exceeding 3 inches.
[5] Includes expenditures which companies could not allocate to product groups.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table D-16
Stainless and alloy tool steel: U.S. producers' and converters' capital expenditures, Jan. 1, 1990-Mar. 31, 1990

Value (1,000 dollars)

Item	Land and land improvement	Plant and equipment[1] [2]	Other	Total
Raw steelmaking facilities:				
Electric furnace	***	3,809	***	3,809
Secondary steelmaking facilities[3]	***	737	***	737
Flat-rolled products:				
Plate mills	***	1,483	***	1,495
Sheets and strip:				
Hot-strip mills	***	***	***	***
Cold-rolled sheet mills	***	5,712	***	6,095
Bars and shapes:				
Hot-finished	***	783	***	785
Cold-finished	***	777	***	782
Wire rod mills	***	***	***	***
Wire-drawing machines	***	1,114	***	1,132
Pipes and tubes:				
Seamless pipe mills	***	***	***	***
Welded pipe mills	***	***	***	***
Other pipe and tube mills	***	***	***	***
Other[4]	***	2,573	***	2,815
Total	64	23,503	598	24,165

[1] Includes expenditures for the specific type of facility as well as related facilities.
[2] Includes expenditures for pollution control and occupational safety and health (OSH).
[3] Includes ladle treatment (heat balance, alloy addition, degassing, decarburization, etc.)and other (vacuum arc remelt, electroslag remelting, etc.) secondary refining processes.
[4] Includes expenditures which companies could not allocate to product groups.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table D-17
Research and development expenditures during 1989, and Jan.-Mar. 1990, by process and product

Item	1989		Jan.-Mar. 1990	
	Carbon and certain alloy[1]	Stainless and alloy tool	Carbon and certain alloy[1]	Stainless and alloy tool
Cokemaking facilities	4,403	(2)	1,126	(2)
Ironmaking facilities	4,461	(2)	1,156	(2)
Raw steelmaking facilities:				
Basic oxygen process	15,349	(2)	4,036	(2)
Electric furnace	7,016	3,066	2,862	642
Other	2,165	(2)	***	(2)
Secondary steelmaking facilities[3]	1,065	1,141	***	***
Flat-rolled products:				
Plate mills	5,654	***	1,457	***
Sheets and strip:				
Hot-strip mills	14,928	***	4,002	371
Cold-rolled sheet mills	19,613	***	3,694	***
Galvanizing facilities	16,098	(2)	4,154	(2)
Other coating facilities	10,864	(2)	2,812	(2)
Bar and light structural mills:				
Hot-finished	4,834	***	1,122	***
Cold-finished	1,059	***	***	***
Medium and heavy structural mills[4]	2,016	(2)	179	(2)
Rail mills	454	(2)	130	(2)
Wire rod mills	***	***	***	***
Wire-drawing machines	3,883	240	237	***
Wire products	1,398	(2)	404	(2)
Pipes and tubes:				
Seamless pipe mills	2,560	***	874	***
Welded pipe mills	***	***	407	15
Other pipe and tube mills	***	***	***	***
Other[5]	8,299	***	2,527	3,257
Total	129,479	43,934	32,048	5,560

[1] Certain alloy refers to alloy steel other than stainless and alloy tool steel.
[2] None reported.
[3] Includes ladle treatment (heat balance, alloy addition, degassing, decarburization, etc.) and other (vacuum ar remelt, electroslag remelting, etc.) secondary refining processes.
[4] Structural shapes with a cross section exceeding 3 inches.
[5] Includes expenditures which could not be effectively allocated to product groups.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

APPENDIX E
QUALITY AND SERVICE RANKING FOR THE U.S. AND MAJOR INTERNATIONAL INDUSTRIES

Table E-1

Carbon and alloy (other than stainless or tool) steel plates, sheets and strip: U.S. producers' assessments[1] of the extent to which they have improved their product quality and customer service fi Jan. 1, 1985 to April 1990

Item	Degree of improvement: Little or none	Limited	Significant	No. of response
	Percent			
Quality:				
Overall[2]	8	39	54	39
Internal quality[3]	5	38	57	37
Dimensional quality[4]	8	37	55	38
Surface quality[5]	8	40	53	38
Properties[6]	5	57	38	37
Presentation&	16	45	40	38
Service:				
Overall[2]	10	32	59	41
Delivery reliability	20	39	42	41
Technical assistance	5	40	55	40
Responsiveness to complaints	5	35	60	40
Financial terms[8]	22	42	36	36

[1] U.S. steel producers were asked to provide a self-evaluation of their company's respective performance.
[2] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.
[3] Includes chemistry, microstructure, grain size, and inclusions.
[4] Includes shape, size, length, straightness, and flatness.
[5] Includes seams, smoothness, and shearing.
[6] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[7] Includes packaging and marking.
[8] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-2

Carbon and alloy (other than stainless or tool) steel bars, rods, shapes, and rails: U.S. producers' assessments of the extent to which they have improved their product quality and customer service fr Jan. 1, 1985 to April 1990

Item	Degree of improvement: Little or none	Limited	Significant	No. of response
	Percent			
Quality:				
Overall[2]	9	46	46	66
Internal quality[3]	13	48	40	63
Dimensional quality[4]	13	40	46	67
Surface quality[5]	14	52	34	67
Properties[6]	13	42	45	64
Presentation[7]	20	45	34	64
Service:				
Overall[2]	4	46	50	68
Delivery reliability	10	43	47	68
Technical assistance	17	35	49	66
Responsiveness to complaints	11	34	55	67
Financial terms[8]	21	46	33	66

[1] U.S. steel producers were asked to provide a self-evaluation of their company's respective performance.
[2] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.
[3] Includes chemistry, microstructure, grain size, and inclusions.
[4] Includes shape, size, length, straightness, and flatness.
[5] Includes seams, smoothness, and shearing.
[6] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[7] Includes packaging and marking.
[8] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

ıble E-3

arbon and alloy (other than stainless or tool) pipes and tubes:U.S. producers' assessments of the ‹tent to which they have improved their product quality and customer service from Jan. 1, 1985 to pril 1990

ɜm	Degree of improvement: Little or none	Limited	Significant	No. of responses
	Percent			
uality:				
Overall[2]	3	21	76	29
Internal quality[3]	0	36	64	28
Dimensional quality[4]	10	31	59	29
Surface quality[5]	11	43	46	28
Properties[6]	7	26	67	27
Presentation[7]	10	48	41	29
ɜrvice:				
Overall[2]	7	18	75	28
Delivery reliability	4	50	46	28
Technical assistance	4	19	78	27
Responsiveness to complaints	8	19	73	26
Financial terms[8]	20	32	48	25

[1] U.S. steel producers were asked to provide a self-evaluation of their company's respective performance.
[2] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of ıe listed elements.
[3] Includes chemistry, microstructure, grain size, and inclusions.
[4] Includes shape, size, length, straightness, and flatness.
[5] Includes seams, smoothness, and shearing.
[6] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[7] Includes packaging and marking.
[8] Includes credit terms, credit availability, and relative interest rates.

ɔurce: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

ıble E-4

:ainless and alloy tool steel plates, sheets and strip: U.S. producers' assessments of the extent to hich they have improved their product quality and customer service from Jan. 1, 1985 to April 1990

ɜm	Degree of improvement: Little or none	Limited	Significant	No. of responses
	Percent			
ıality:				
Overall[2]	0	11	90	19
Internal quality[3]	6	24	71	17
Dimensional quality[4]	0	22	78	18
Surface quality[5]	0	50	50	18
Properties[6]	6	18	77	17
Presentation[7]	11	32	58	19
ɜrvice:				
Overall[2]	0	37	63	19
Delivery reliability	5	53	42	19
Technical assistance	11	17	72	18
Responsiveness to complaints	0	39	61	18
Financial terms[8]	13	40	47	15

[1] U.S. steel producers were asked to provide a self-evaluation of their company's respective performance.
[2] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.
[3] Includes chemistry, microstructure, grain size, and inclusions.
[4] Includes shape, size, length, straightness, and flatness.
[5] Includes seams, smoothness, and shearing.
[6] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[7] Includes packaging and marking.
[8] Includes credit terms, credit availability, and relative interest rates.

ɹurce: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-5

Stainless and alloy tool steel bars, rods, and shapes: U.S. producers' assessments of the extent to which they have improved their product quality and customer service from Jan. 1, 1985 to April 1990

Item	Degree of improvement: Little or none	Limited	Significant	No. of response
	Percent			
Quality:				
Overall[2]	6	35	59	17
Internal quality[3]	12	35	53	17
Dimensional quality[4]	12	24	65	17
Surface quality[5]	12	53	35	17
Properties[6]	19	38	44	16
Presentation[7]	19	44	38	16
Service:				
Overall[2]	0	53	47	17
Delivery reliability	12	35	53	17
Technical assistance	0	47	53	17
Responsiveness to complaints	6	41	53	17
Financial terms[8]	18	53	29	17

[1] U.S. steel producers were asked to provide a self-evaluation of their company's respective performance.
[2] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each o the listed elements.
[3] Includes chemistry, microstructure, grain size, and inclusions.
[4] Includes shape, size, length, straightness, and flatness.
[5] Includes seams, smoothness, and shearing.
[6] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[7] Includes packaging and marking.
[8] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission

Table E-6

Stainless and alloy tool steel pipes and tubes: U.S. producers' assessments of the extent to which th have improved their product quality and customer service from Jan. 1, 1985 to April 1990

Item	Degree of improvement: Little or none	Limited	Significant	No. of respons
	Percent			
Quality:				
Overall[2]	0	75	25	4
Internal quality[3]	25	25	50	4
Dimensional quality[4]	25	75	0	4
Surface quality[5]	0	75	25	4
Properties[6]	0	50	50	4
Presentation[7]	50	0	50	4
Service:				
Overall[2]	0	100	0	4
Delivery reliability	0	100	0	4
Technical assistance	0	50	50	4
Responsiveness to complaints	0	50	50	4
Financial terms[8]	25	50	25	4

[1] U.S. steel producers were asked to provide a self-evaluation of their company's respective performance.
[2] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each the listed elements.
[3] Includes chemistry, microstructure, grain size, and inclusions.
[4] Includes shape, size, length, straightness, and flatness.
[5] Includes seams, smoothness, and shearing.
[6] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[7] Includes packaging and marking.
[8] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commissior

Table E-7

Carbon and alloy (other than stainless or tool) steel plates, sheets and strip: U.S. purchasers' assessments[1] of the extent to which U.S. producers have improved their product quality and customer service from Jan. 1, 1985 to April 1990

Item	Degree of improvement: Little or none	Limited	Significant	No. of responses
	Percent			
Quality:				
Overall[2]	12	49	38	178
Internal quality[3]	17	55	28	166
Dimensional quality[4]	18	51	32	174
Surface quality[5]	22	47	31	172
Properties[6]	24	53	24	165
Presentation[7]	30	49	21	164
Service:				
Overall[2]	17	61	22	179
Delivery reliability	29	48	23	177
Technical assistance	23	52	25	174
Responsiveness to complaints	21	53	26	176
Financial terms[8]	45	41	14	168

[1] U.S. steel purchasers were asked to provide an assessment of the performance of the U.S. steel producers with whom they conduct business.
[2] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.
[3] Includes chemistry, microstructure, grain size, and inclusions.
[4] Includes shape, size, length, straightness, and flatness.
[5] Includes seams, smoothness, and shearing.
[6] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[7] Includes packaging and marking.
[8] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-8

Carbon and alloy (other than stainless or tool) steel bars, rods, shapes, and rails: U.S. purchasers' assessments of the extent to which U.S. producers have improved their product quality and customer service from Jan. 1, 1985 to April 1990

Item	Degree of improvement: Little or none	Limited	Significant	No. of responses
	Percent			
Quality:				
Overall[2]	18	56	26	125
Internal quality[3]	24	55	22	119
Dimensional quality[4]	26	48	26	124
Surface quality[5]	29	50	21	122
Properties[6]	31	47	22	116
Presentation[7]	31	44	25	118
Service:				
Overall[2]	18	59	24	130
Delivery reliability	25	49	27	130
Technical assistance	26	52	21	126
Responsiveness to complaints	22	50	28	129
Financial terms[8]	45	38	17	124

[1] U.S. steel purchasers were asked to provide an assessment of the performance of the U.S. steel producers with whom they conduct business.
[2] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.
[3] Includes chemistry, microstructure, grain size, and inclusions.
[4] Includes shape, size, length, straightness, and flatness.
[5] Includes seams, smoothness, and shearing.
[6] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[7] Includes packaging and marking.
[8] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-9

Carbon and alloy (other than stainless or tool) pipes and tubes:U.S. purchasers' assessments of the extent to which U.S. producers have improved their product quality and customer service from Jan. 1, 1985 to April 1990

Item	Degree of improvement: Little or none	Limited	Significant	No. of responses
	Percent			
Quality:				
Overall[2]	26	57	17	84
Internal quality[3]	27	55	18	78
Dimensional quality[4]	26	60	15	82
Surface quality[5]	27	54	19	81
Properties[6]	42	43	15	79
Presentation[7]	35	49	16	80
Service:				
Overall[2]	20	61	19	85
Delivery reliability	24	54	22	83
Technical assistance	34	45	21	80
Responsiveness to complaints	24	58	18	83
Financial terms[8]	53	37	10	79

[1] U.S. steel purchasers were asked to provide an assessment of the performance of the U.S. steel producers with whom they conduct business.
[2] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.
[3] Includes chemistry, microstructure, grain size, and inclusions.
[4] Includes shape, size, length, straightness, and flatness.
[5] Includes seams, smoothness, and shearing.
[6] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[7] Includes packaging and marking.
[8] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-10

Stainless and alloy tool steel plates, sheets and strip: U.S. purchasers' assessments of the extent to which U.S. producers have improved their product quality and customer service from Jan. 1, 1985 to April 1990

Item	Degree of improvement: Little or none	Limited	Significant	No. of responses
	Percent			
Quality:				
Overall[2]	19	53	28	68
Internal quality[3]	27	47	27	64
Dimensional quality[4]	24	53	23	66
Surface quality[5]	28	46	25	67
Properties[6]	32	48	21	63
Presentation&	33	44	23	61
Service:				
Overall[2]	17	61	22	69
Delivery reliability	25	52	24	68
Technical assistance	21	56	23	66
Responsiveness to complaints	27	49	24	67
Financial terms[8]	42	45	13	62

[1] U.S. steel purchasers were asked to provide an assessment of the performance of the U.S. steel producers with whom they conduct business.
[2] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.
[3] Includes chemistry, microstructure, grain size, and inclusions.
[4] Includes shape, size, length, straightness, and flatness.
[5] Includes seams, smoothness, and shearing.
[6] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[7] Includes packaging and marking.
[8] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-11

Stainless and alloy tool steel bars, rods, and shapes: U.S. purchasers' assessments of the extent to which U.S. producers have improved their product quality and customer service from Jan. 1, 1985 to April 1990

Item	Degree of improvement: Little or none	Limited	Significant	No. of responses
	Percent			
Quality:				
Overall[2]	19	60	21	48
Internal quality[3]	18	68	14	44
Dimensional quality[4]	26	57	17	46
Surface quality[5]	23	57	19	47
Properties[6]	29	60	11	45
Presentation[7]	36	43	21	44
Service:				
Overall[2]	19	60	21	52
Delivery reliability	24	59	18	51
Technical assistance	14	68	18	50
Responsiveness to complaints	22	53	26	51
Financial terms[8]	43	45	13	47

[1] U.S. steel purchasers were asked to provide an assessment of the performance of the U.S. steel producers with whom they conduct business.
[2] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.
[3] Includes chemistry, microstructure, grain size, and inclusions.
[4] Includes shape, size, length, straightness, and flatness.
[5] Includes seams, smoothness, and shearing.
[6] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[7] Includes packaging and marking.
[8] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-12

Stainless and alloy tool steel pipes and tubes: U.S. purchasers' assessments of the extent to which U.S. producers have improved their product quality and customer service from Jan. 1, 1985 to April 1990

Item	Degree of improvement: Little or none	Limited	Significant	No. of responses
	Percent			
Quality:				
Overall[2]	29	46	25	28
Internal quality[3]	23	50	27	26
Dimensional quality[4]	33	48	19	27
Surface quality[5]	33	48	19	27
Properties[6]	33	52	15	27
Presentation[7]	30	56	15	27
Service:				
Overall[2]	26	48	26	31
Delivery reliability	30	50	20	30
Technical assistance	17	62	21	29
Responsiveness to complaints	30	43	27	30
Financial terms[8]	44	41	15	27

[1] U.S. steel purchasers were asked to provide an assessment of the performance of theU.S. steel producers with whom they conduct business.
[2] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.
[3] Includes chemistry, microstructure, grain size, and inclusions.
[4] Includes shape, size, length, straightness, and flatness.
[5] Includes seams, smoothness, and shearing.
[6] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[7] Includes packaging and marking.
[8] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-13

U.S. producers' assessments[1] of their company's product quality and customer service for carbon an alloy (other than stainless or tool) steel plates, sheets, and strip,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of response
			Percent		
Quality:					
Overall[3]	2	17	69	12	42
Internal quality	2	12	55	31	42
Dimensional quality[5]	0	24	48	29	42
Surface quality[6]	5	24	57	14	42
Coating quality	0	11	67	22	27
Properties[7]	2	5	56	37	41
Presentation[8]	2	15	56	27	41
Service:					
Overall[3]	0	22	63	15	41
Delivery reliability	12	39	39	10	41
Technical assistance	2	10	51	37	41
Responsiveness to complaints	0	20	46	34	41
Financial terms[9]	0	5	74	21	39

[1] U.S. steel producers were asked to provide a self-evaluation of their company's respective performance.
[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined virtually no problems encountered.
[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each o the listed elements.
[4] Includes chemistry, microstructure, grain size, and inclusions.
[5] Includes shape, size, length, straightness, and flatness.
[6] Includes seams, smoothness, and shearing.
[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[8] Includes packaging and marking.
[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-14

U.S. producers' assessments[1] of their company's product quality and customer service for carbon an alloy (other than stainless or tool) steel bars, rods, shapes, and rails,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of response
			Percent		
Quality:					
Overall[3]	0	15	71	14	65
Internal quality[4]	0	10	58	32	62
Dimensional quality[5]	0	14	66	20	64
Surface quality[6]	3	23	59	14	64
Coating quality	0	24	59	17	29
Properties[7]	0	10	54	36	61
Presentation[8]	2	16	56	27	63
Service:					
Overall[3]	0	7	63	31	62
Delivery reliability	3	5	63	29	62
Technical assistance	2	13	47	38	60
Responsiveness to complaints	0	7	45	48	62
Financial terms[9]	0	19	52	29	62

[1] U.S. steel producers were asked to provide a self-evaluation of their company's respective performance.
[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined virtually no problems encountered.
[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each o the listed elements.
[4] Includes chemistry, microstructure, grain size, and inclusions.
[5] Includes shape, size, length, straightness, and flatness.
[6] Includes seams, smoothness, and shearing.
[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[8] Includes packaging and marking.
[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission

Table E-15

U.S. producers' assessments[1] of their company's product quality and customer service for carbon and alloy (other than stainless or tool) steel pipes and tubes,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
		Percent			
Quality:					
Overall[3]	0	3	69	28	32
Internal quality[4]	0	10	53	37	30
Dimensional quality[5]	0	10	48	42	31
Surface quality[6]	0	16	55	29	31
Coating quality	0	26	57	17	23
Properties[7]	0	7	47	47	30
Presentation[8]	0	13	50	37	30
Service:					
Overall[3]	0	3	66	31	29
Delivery reliability	7	20	47	27	30
Technical assistance	0	7	48	45	29
Responsiveness to complaints	0	7	57	37	30
Financial terms[9]	0	18	50	32	28

[1] U.S. steel producers were asked to provide a self-evaluation of their company's respective performance.
[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined as virtually no problems encountered.
[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.
[4] Includes chemistry, microstructure, grain size, and inclusions.
[5] Includes shape, size, length, straightness, and flatness.
[6] Includes seams, smoothness, and shearing.
[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[8] Includes packaging and marking.
[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-16

U.S. producers' assessments[1] of their company's product quality and customer service for stainless and tool steel bars, rods, and shapes,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
		Percent			
Quality:					
Overall[3]	0	30	55	15	20
Internal quality[4]	0	20	60	20	20
Dimensional quality[5]	0	20	50	30	20
Surface quality[6]	0	35	50	15	20
Coating quality	0	50	50	0	6
Properties[7]	0	15	45	40	20
Presentation[8]	0	21	47	32	19
Service:					
Overall[3]	0	22	61	17	18
Delivery reliability	6	39	44	11	18
Technical assistance	0	22	28	50	18
Responsiveness to complaints	0	11	39	50	18
Financial terms[9]	0	11	67	22	18

[1] U.S. steel producers were asked to provide a self-evaluation of their company's respective performance.
[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined as virtually no problems encountered.
[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.
[4] Includes chemistry, microstructure, grain size, and inclusions.
[5] Includes shape, size, length, straightness, and flatness.
[6] Includes seams, smoothness, and shearing.
[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[8] Includes packaging and marking.
[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-17

U.S. producers' assessments[1] of their company's product quality and customer service for stainless and tool steel pipes and tubes,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
		Percent			
Quality:					
Overall[3]	0	25	50	25	4
Internal quality[4]	0	25	50	25	4
Dimensional quality[5]	0	75	0	25	4
Surface quality[6]	0	50	25	25	4
Coating quality	0	50	50	0	2
Properties[7]	0	25	50	25	4
Presentation[8]	0	25	50	25	4
Service:					
Overall[3]	0	25	75	0	4
Delivery reliability	0	75	25	0	4
Technical assistance	0	25	50	25	4
Responsiveness to complaints	0	25	50	25	4
Financial terms[9]	0	25	75	0	4

[1] U.S. steel producers were asked to provide a self-evaluation of their company's respective performance.
[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined as virtually no problems encountered.
[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.
[4] Includes chemistry, microstructure, grain size, and inclusions.
[5] Includes shape, size, length, straightness, and flatness.
[6] Includes seams, smoothness, and shearing.
[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[8] Includes packaging and marking.
[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-18

U.S. producers' assessments[1] of their company's quality and service for stainless and tool steel plates, sheets, and strip,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
		Percent			
Quality:					
Overall[3]	0	14	76	10	21
Internal quality[4]	0	19	48	33	21
Dimensional quality[5]	0	10	67	24	21
Surface quality[6]	0	29	62	10	21
Coating quality	0	50	25	25	4
Properties[7]	0	10	38	52	21
Presentation[8]	0	10	52	38	21
Service:					
Overall[3]	0	19	57	24	21
Delivery reliability	10	33	48	10	21
Technical assistance	0	19	52	29	21
Responsiveness to complaints	0	14	57	29	21
Financial terms[9]	0	11	72	17	18

[1] U.S. steel producers were asked to provide a self-evaluation of their company's respective performance.
[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined as virtually no problems encountered.
[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.
[4] Includes chemistry, microstructure, grain size, and inclusions.
[5] Includes shape, size, length, straightness, and flatness.
[6] Includes seams, smoothness, and shearing.
[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[8] Includes packaging and marking.
[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

able E-19

urchasers' assessments[1] of U.S. product quality and customer service for carbon and alloy (other than tainless or tool) steel plates, sheets, and strip,[2] April 1990

lement	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
			Percent		
uality:					
Overall[3]	2	45	50	3	175
Internal quality[4]	2	44	47	7	170
Dimensional quality[5]	3	44	47	6	176
Surface quality[6]	3	45	45	8	173
Properties[7]	2	34	49	15	170
Presentation[8]	5	38	46	11	169
ervice:					
Overall[3]	7	44	43	6	175
Delivery reliability	15	49	29	7	177
Technical assistance	8	37	44	12	174
Responsiveness to complaints	9	34	46	11	175
Financial terms[9]	11	43	34	12	169

[1] Assessments of country's performance were made by purchasers for companies with whom they conducted usiness.
[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but roblems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined as irtually no problems encountered.
[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of ne listed elements.
[4] Includes chemistry, microstructure, grain size, and inclusions.
[5] Includes shape, size, length, straightness, and flatness.
[6] Includes seams, smoothness, and shearing.
[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[8] Includes packaging and marking.
[9] Includes credit terms, credit availability, and relative interest rates.

ource: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

able E-20

urchasers' assessments[1] of U.S. product quality and customer service for carbon and alloy (other than tainless or tool) steel bars, rods, shapes, and rails,[2] April 1990

lement	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
			Percent		
uality:					
Overall[3]	2	42	48	8	132
Internal quality[4]	2	38	50	10	128
Dimensional quality[5]	2	38	44	15	133
Surface quality[6]	5	41	46	8	133
Properties[7]	2	37	46	16	127
Presentation[8]	5	37	45	13	131
ervice:					
Overall[3]	4	37	47	12	135
Delivery reliability	9	36	44	11	135
Technical assistance	4	38	44	14	129
Responsiveness to complaints	8	36	41	15	132
Financial terms[9]	8	44	34	14	125

[1] Assessments of country's performance were made by purchasers for companies with whom they conducted usiness.
[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but roblems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined as irtually no problems encountered.
[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of ne listed elements.
[4] Includes chemistry, microstructure, grain size, and inclusions.
[5] Includes shape, size, length, straightness, and flatness.
[6] Includes seams, smoothness, and shearing.
[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[8] Includes packaging and marking.
[9] Includes credit terms, credit availability, and relative interest rates.

ource: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-21

Purchasers' assessments[1] of U.S. product quality and customer service for carbon and alloy (other t stainless or tool) steel pipes and tubes,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of respons
			Percent		
Quality:					
Overall[3]	1	41	44	14	86
Internal quality[4]	1	35	45	18	82
Dimensional quality[5]	0	43	43	15	87
Surface quality[6]	0	42	41	17	86
Properties[7]	1	34	45	20	82
Presentation[8]	1	37	45	17	84
Service:					
Overall[3]	6	30	52	12	90
Delivery reliability	6	46	30	18	89
Technical assistance	5	40	44	12	86
Responsiveness to complaints	5	38	39	18	87
Financial terms[9]	9	45	33	13	82

[1] Assessments of country's performance were made by purchasers for companies with whom they conducte business.

[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was definec virtually no problems encountered.

[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each c the listed elements.

[4] Includes chemistry, microstructure, grain size, and inclusions.

[5] Includes shape, size, length, straightness, and flatness.

[6] Includes seams, smoothness, and shearing.

[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.

[8] Includes packaging and marking.

[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission

Table E-22

Purchasers' assessments[1] of U.S. product quality and customer service for stainless and tool steel plates, sheets, and strip,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of respons
			Percent		
Quality:					
Overall[3]	4	33	56	7	72
Internal quality[4]	1	40	43	16	70
Dimensional quality[5]	3	40	45	12	73
Surface quality[6]	6	38	45	11	73
Properties[7]	4	35	38	23	71
Presentation[8]	4	37	42	17	71
Service:					
Overall[3]	5	40	46	9	76
Delivery reliability	15	42	37	7	76
Technical assistance	7	40	37	16	73
Responsiveness to complaints	7	38	41	14	73
Financial terms[9]	12	41	30	17	69

[1] Assessments of country's performance were made by purchasers for companies with whom they conducte business.

[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was definec virtually no problems encountered.

[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each c the listed elements.

[4] Includes chemistry, microstructure, grain size, and inclusions.

[5] Includes shape, size, length, straightness, and flatness.

[6] Includes seams, smoothness, and shearing.

[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.

[8] Includes packaging and marking.

[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission

Table E-23

Purchasers' assessments[1] of U.S. product quality and customer service for stainless and tool steel bars, rods, and shapes,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
		Percent			
Quality:					
Overall[3]	0	46	52	2	46
Internal quality[4]	0	44	52	4	46
Dimensional quality[5]	0	45	49	6	47
Surface quality[6]	2	53	38	7	45
Properties[7]	7	33	57	4	46
Presentation[8]	4	37	54	4	46
Service:					
Overall[3]	4	41	51	4	51
Delivery reliability	12	47	39	2	51
Technical assistance	0	40	54	6	48
Responsiveness to complaints	6	42	44	8	50
Financial terms[9]	7	41	41	11	46

[1] Assessments of country's performance were made by purchasers for companies with whom they conducted business.

[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined as virtually no problems encountered.

[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.

[4] Includes chemistry, microstructure, grain size, and inclusions.

[5] Includes shape, size, length, straightness, and flatness.

[6] Includes seams, smoothness, and shearing.

[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.

[8] Includes packaging and marking.

[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-24

Purchasers' assessments[1] of U.S. product quality and customer service for stainless and tool steel pipes and tubes,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
		Percent			
Quality:					
Overall[3]	0	55	35	10	29
Internal quality[4]	0	45	41	14	29
Dimensional quality[5]	3	50	37	10	30
Surface quality[6]	0	55	35	10	29
Properties[7]	3	45	38	14	29
Presentation[8]	3	52	35	10	29
Service:					
Overall[3]	15	35	44	6	34
Delivery reliability	18	38	38	6	34
Technical assistance	6	49	33	12	33
Responsiveness to complaints	10	39	42	10	31
Financial terms[9]	7	43	46	4	28

[1] Assessments of country's performance were made by purchasers for companies with whom they conducted business.

[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined as virtually no problems encountered.

[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.

[4] Includes chemistry, microstructure, grain size, and inclusions.

[5] Includes shape, size, length, straightness, and flatness.

[6] Includes seams, smoothness, and shearing.

[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.

[8] Includes packaging and marking.

[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-25

Purchasers' assessments[1] of Japanese product quality and customer service for carbon and alloy (other than stainless or tool) steel plates, sheets, and strip,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
			Percent		
Quality:					
Overall[3]	0	17	48	35	60
Internal quality[4]	4	11	40	46	57
Dimensional quality[5]	2	13	37	48	60
Surface quality[6]	2	14	35	50	58
Properties[7]	4	19	30	47	57
Presentation[8]	2	16	39	44	57
Service:					
Overall[3]	5	28	53	13	60
Delivery reliability	7	31	48	15	61
Technical assistance	10	29	37	24	59
Responsiveness to complaints	9	29	42	20	59
Financial terms[9]	7	38	38	18	56

[1] Assessments of country's performance were made by purchasers for companies with whom they conducted business.

[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined as virtually no problems encountered.

[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.

[4] Includes chemistry, microstructure, grain size, and inclusions.

[5] Includes shape, size, length, straightness, and flatness.

[6] Includes seams, smoothness, and shearing.

[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.

[8] Includes packaging and marking.

[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-26

Purchasers' assessments[1] of Japanese product quality and customer service for carbon and alloy (other than stainless or tool) steel bars, rods, shapes, and rails,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
			Percent		
Quality:					
Overall[3]	0	13	28	59	32
Internal quality[4]	0	7	42	52	31
Dimensional quality[5]	0	6	41	53	32
Surface quality[6]	0	7	29	65	31
Properties[7]	0	6	34	59	32
Presentation[8]	0	9	41	50	32
Service:					
Overall[3]	0	35	38	27	34
Delivery reliability	6	32	38	24	34
Technical assistance	9	30	42	18	33
Responsiveness to complaints	0	24	49	27	33
Financial terms[9]	7	23	50	20	30

[1] Assessments of country's performance were made by purchasers for companies with whom they conducted business.

[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined as virtually no problems encountered.

[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.

[4] Includes chemistry, microstructure, grain size, and inclusions.

[5] Includes shape, size, length, straightness, and flatness.

[6] Includes seams, smoothness, and shearing.

[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.

[8] Includes packaging and marking.

[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-27

Purchasers' assessments[1] of Japanese product quality and customer service for carbon and alloy (other than stainless or tool) steel pipes and tubes,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
			Percent		
Quality:					
Overall[3]	0	7	47	47	15
Internal quality[4]	0	7	33	60	15
Dimensional quality[5]	7	7	27	60	15
Surface quality[6]	0	7	40	53	15
Properties[7]	0	7	27	67	15
Presentation[8]	0	7	43	50	14
Service:					
Overall[3]	7	13	53	27	15
Delivery reliability	7	27	40	27	15
Technical assistance	0	36	36	29	14
Responsiveness to complaints	20	13	33	33	15
Financial terms[9]	8	39	39	15	13

[1] Assessments of country's performance were made by purchasers for companies with whom they conducted business.

[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined as virtually no problems encountered.

[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.

[4] Includes chemistry, microstructure, grain size, and inclusions.

[5] Includes shape, size, length, straightness, and flatness.

[6] Includes seams, smoothness, and shearing.

[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.

[8] Includes packaging and marking.

[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-28

Purchasers' assessments[1] of Japanese product quality and customer service for stainless and tool steel plates, sheets, and strip,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
			Percent		
Quality:					
Overall[3]	8	33	33	25	12
Internal quality[4]	0	39	23	39	13
Dimensional quality[5]	0	23	39	39	13
Surface quality[6]	0	31	31	39	13
Properties[7]	0	39	23	39	13
Presentation[8]	0	39	46	15	13
Service:					
Overall[3]	6	50	38	6	16
Delivery reliability	6	38	50	6	16
Technical assistance	6	50	19	25	16
Responsiveness to complaints	7	47	33	13	15
Financial terms[9]	13	20	47	20	15

[1] Assessments of country's performance were made by purchasers for companies with whom they conducted business.

[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined as virtually no problems encountered.

[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.

[4] Includes chemistry, microstructure, grain size, and inclusions.

[5] Includes shape, size, length, straightness, and flatness.

[6] Includes seams, smoothness, and shearing.

[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.

[8] Includes packaging and marking.

[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table E-29

Purchasers' assessments[1] of Japanese product quality and customer service for stainless and tool st bars, rods, and shapes,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of response
		Percent			
Quality:					
Overall[3]	0	27	18	55	11
Internal quality[4]	0	27	27	46	11
Dimensional quality[5]	0	27	27	46	11
Surface quality[6]	0	18	36	46	11
Properties[7]	0	27	36	36	11
Presentation[8]	0	18	36	46	11
Service:					
Overall[3]	0	43	43	14	14
Delivery reliability	0	50	43	7	14
Technical assistance	0	64	29	7	14
Responsiveness to complaints	0	62	31	8	13
Financial terms[9]	0	50	33	17	12

[1] Assessments of country's performance were made by purchasers for companies with whom they conductec business.

[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined virtually no problems encountered.

[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each c the listed elements.

[4] Includes chemistry, microstructure, grain size, and inclusions.

[5] Includes shape, size, length, straightness, and flatness.

[6] Includes seams, smoothness, and shearing.

[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.

[8] Includes packaging and marking.

[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission

Table E-30

Purchasers' assessments[1] of Canadian product quality and customer service for carbon and alloy (ot than stainless or tool) steel plates, sheets, and strip,[2] April 1990

Element	Less than satisfactory	Satisfactory	Good	Excellent	No. of respons
		Percent			
Quality:					
Overall[3]	0	38	50	12	34
Internal quality[4]	0	36	46	18	33
Dimensional quality[5]	6	33	49	12	33
Surface quality[6]	6	38	38	19	32
Properties[7]	3	27	47	23	30
Presentation[8]	0	26	48	26	31
Service:					
Overall[3]	6	47	44	3	32
Delivery reliability	9	41	41	9	32
Technical assistance	6	50	34	9	32
Responsiveness to complaints	9	47	41	3	32
Financial terms[9]	7	45	35	14	29

[1] Assessments of country's performance were made by purchasers for companies with whom they conducted business.

[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined as virtually no problems encountered.

[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of the listed elements.

[4] Includes chemistry, microstructure, grain size, and inclusions.

[5] Includes shape, size, length, straightness, and flatness.

[6] Includes seams, smoothness, and shearing.

[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.

[8] Includes packaging and marking.

[9] Includes credit terms, credit availability, and relative interest rates.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commissio

able E-31

urchasers' assessments[1] of Canadian product quality and customer service for carbon and alloy (other ıan stainless or tool) steel bars, rods, shapes, and rails,[2] April 1990

lement	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
			Percent		
uality:					
Overall[3]	0	30	60	10	30
Internal quality[4]	0	33	60	7	30
Dimensional quality[5]	3	30	57	10	30
Surface quality[6]	0	37	53	10	30
Properties[7]	0	28	62	10	29
Presentation[8]	0	43	40	17	30
ervice:					
Overall[3]	0	47	37	17	30
Delivery reliability	7	32	42	19	31
Technical assistance	10	40	37	13	30
Responsiveness to complaints	3	39	39	19	31
Financial terms[9]	3	31	59	7	29

[1] Assessments of country's performance were made by purchasers for companies with whom they conducted usiness.
[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but problems are effectively resolved. Good was further defined as occasional minor problems. xcellent was defined as virtually no problems encountered.
[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of ıe listed elements.
[4] Includes chemistry, microstructure, grain size, and inclusions.
[5] Includes shape, size, length, straightness, and flatness.
[6] Includes seams, smoothness, and shearing.
[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[8] Includes packaging and marking.
[9] Includes credit terms, credit availability, and relative interest rates.

ource: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

able E-32

'urchasers' assessments[1] of French product quality and customer service for stainless and tool steel lates, sheets, and strip,[2] April 1990

lement	Less than satisfactory	Satisfactory	Good	Excellent	No. of responses
			Percent		
uality:					
Overall[3]	0	39	39	23	13
Internal quality[4]	0	50	21	29	14
Dimensional quality[5]	0	50	29	21	14
Surface quality[6]	7	29	50	14	14
Properties[7]	0	43	36	21	14
Presentation[8]	7	50	29	14	14
ervice:					
Overall[3]	20	47	33	0	15
Delivery reliability	20	53	27	0	15
Technical assistance	13	67	20	0	15
Responsiveness to complaints	29	43	29	0	14
Financial terms[9]	7	47	40	7	15

[1] Assessments of country's performance were made by purchasers for companies with whom they conducted usiness.
[2] The term satisfactory was further defined in questionnaires as follows: periodic problems encountered but roblems are effectively resolved. Good was further defined as occasional minor problems. Excellent was defined as irtually no problems encountered.
[3] Reflects an overall assessment of quality/customer service on the basis of the relative importance of each of ıe listed elements.
[4] Includes chemistry, microstructure, grain size, and inclusions.
[5] Includes shape, size, length, straightness, and flatness.
[6] Includes seams, smoothness, and shearing.
[7] Includes tensile strength, ductility, hardness, wear and corrosion resistance, and weldability.
[8] Includes packaging and marking.
[9] Includes credit terms, credit availability, and relative interest rates.

ource: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

APPENDIX F
STATISTICAL TABLES FOR THE INTERNATIONAL STEEL INDUSTRY

Table F-1

Steel: Certain announced joint venture arrangements, January 1989 to May 1990

Joint venture location	*Country and partner company*	*Percent ownership*	*Products*
Belgium	Italy, Riva	70	Long products
	Belgium, Cockerill Sambre	30	
West Germany	France, Usinor-Sacilor	70	Wire rods, special, and bearing steel
	Luxembourg, Trade Arbed	27.5	
	West Germany, Saarstahl	2.5	
Hungary	West Germany, Korf	30	Bar and rod
	West Germany, Metallgesellschaft	30	
	Hungary, Ozd	40	
Italy	France, Usinor-Sacilor	51	Welded tube
	Italy, Ilva	49	
To be announced	Korea, Posco	50	Cold-rolled
	(1)	50	
Malaysia	Taiwan, China Steel	49	Plate, hot-rolled cold-rolled
	Malaysian government	51	
Spain	France, Usinor-Sacilor	25	Coated steel
	Spain, Ensidesa	75	
Taiwan	West Germany, Krupp	25	Stainless
	Taiwan, Tuntex	75	
Taiwan	West Germany, Thyssen	(1)	Cold-rolled stainless
	South Africa, Samancor	(1)	
Taiwan	Japan, Sumitomo	25	Stainless pipe and tube
	Japan, Mitsui	25	
	Taiwan, Mayer Steel Pipe Corp	50	
Taiwan	Taiwan, An Feng	(1)	Hot-rolled
	Several Korean firms		
Thailand	Singapore, NISM	40	Reinforcing bars, wire rod
	Thailand, Bangkok Steel	[2]40	
Turkey	France, Usinor-Sacilor	(1)	Cold-rolled
	Italy, Ilva	(1)	
	Turkey, Erdemir and Borusan	51	

[1] Not yet announced.

[2] Remainder to be held by private investor.

Source: *Metal Bulletin*, various issues.

Table F-2

Worldwide raw steelmaking capacity and production, 1989

Country	Capacity (million short tons)	Percen of total	Production (million short tons)	Percent of total	Capacity utilization (Percent)
Soviet Union	•••	•••	176.5	20.4	•••
Japan	158.0	15.1	118.9	13.8	75.3
United States	115.9	11.0	97.4	11.3	84.0
People's Rep. China	•••	•••	67.5	7.8	•••
West Germany	•••	•••	45.3	5.2	•••
Italy	40.6	3.9	27.8	3.2	68.5
Brazil	•••	•••	27.6	3.2	•••
South Korea	•••	•••	24.1	2.8	•••
France	•••	•••	21.3	2.5	•••
United Kingdom	25.1	2.4	20.7	2.4	82.5
Canada	19.7	1.9	17.1	2.0	86.8
Czechoslovakia	•••	•••	17.0	2.0	•••
Poland	•••	•••	16.4	1.9	•••
India	•••	•••	15.9	1.8	•••
Romania	•••	•••	14.9	1.7	•••
Spain	•••	•••	14.1	1.6	•••
Belgium	15.7	1.5	12.1	1.4	77.1
South Africa	•••	•••	10.6	1.2	•••
Taiwan	•••	•••	9.6	1.1	•••
Turkey	9.8	0.9	8.6	1.0	87.8
German Democratic Rep	•••	•••	8.6	1.0	•••
Mexico	•••	•••	8.5	1.0	•••
North Korea	•••	•••	7.5	0.9	•••
Australia	•••	•••	7.4	0.9	•••
Netherlands	•••	•••	6.3	0.7	•••
Sweden	5.6	0.5	5.2	0.6	92.9
Austria	•••	•••	5.2	0.6	•••
Yugoslavia	•••	•••	5.0	0.6	•••
Argentina	•••	•••	4.3	0.5	•••
Luxembourg	6.0	0.6	4.1	0.5	68.3
Hungary	•••	•••	3.7	0.4	•••
Bulgaria	•••	•••	3.3	0.4	•••
Finland	3.4	0.3	3.2	0.4	94.1
Vietnam	•••	•••	(1)	0.0	•••
Greece	•••	•••	1.1	0.1	•••
Switzerland	1.2	0.1	1.0	0.1	83.3
Portugal	0.9	0.1	0.8	0.1	88.9
Norway	•••	•••	0.7	0.1	•••
Denmark	•••	•••	0.7	0.1	•••
New Zealand	•••	•••	0.7	0.1	•••
Cuba	•••	•••	0.6	0.1	•••
Ireland	•••	•••	0.3	0.0	•••
Other	•••	•••	21.8	2.5	•••
Total	•••	•••	863.3	100.0	•••
Memo:					
Industr'd countries	•••	•••	435.6	50.5	•••
Develop'g countries	•••	•••	111.8	12.9	•••
EC(12)	•••	•••	154.6	17.9	•••
Nonmarket economy countries[2]	•••	•••	315.9	36.6	•••

[1] Not available.

[2] Although the economies in a number of these countries are currently undergoing major market-oriented restructuring, they operated as nonmarket economies for the majority of the 1989 time period.

Source: Capacity data compiled from data collected by the Organization for Economic Co-operation and Development. Production data compiled from data collected by the International Iron and Steel Institute, Steel Statistical Yearbook, 1989.

Table F-3

Flat-rolled steel: Certain proposed expansion projects

(1,000 metric tons per year)

Country	*Company or project*	*Products*	*Capacity increase*	*Start-up date*
• • •	• • •	• • •	• • •	• • •
• • •	• • •	• • •	• • •	• • •
• • •	• • •	• • •	• • •	• • •
• • •	• • •	• • •	• • •	• • •
• • •	• • •	• • •	• • •	• • •
• • •	• • •	• • •	• • •	• • •
• • •	• • •	• • •	• • •	• • •
• • •	• • •	• • •	• • •	• • •
• • •	• • •	• • •	• • •	• • •
• • •	• • •	• • •	• • •	• • •

[1] Due to recent privatization plans, these figures may change.

[2] Not available.

Source: • • •

Table F-4

Apparent consumption of finished steel, by country, 1988

Country	Apparent consumption (1,000 short tons)	Share of total (percent)
Soviet Union	143,482	19.9
United States	99,817	13.9
Japan	89,243	12.4
People's Republic of China	61,562	8.5
West Germany	33,504	4.7
Italy	25,765	3.6
France	16,753	2.3
United Kingdom	16,250	2.3
South Korea	15,994	2.2
India	15,778	2.2
Canada	13,779	1.9
Poland	13,398	1.9
Brazil	11,795	1.6
Romania	11,004	1.5
Taiwan	10,450	1.5
Spain	10,040	1.4
Czechoslovakia	9,328	1.3
German Democratic Republic	8,145	1.1
Mexico	6,629	0.9
Turkey	6,446	0.9
Australia	6,234	0.9
South Africa	5,137	0.7
Bulgaria	4,837	0.7
Belgium-Luxembourg	4,264	0.6
Netherlands	4,204	0.6
Yugoslavia	3,509	0.5
Sweden	3,384	0.5
Hungary	2,954	0.4
Argentina	2,607	0.4
Austria	2,504	0.3
Switzerland	2,442	0.3
Finland	1,981	0.3
Greece	1,806	0.3
Denmark	1,728	0.2
Portugal	1,644	0.2
Norway	1,265	0.2
Cuba	1,055	0.1
New Zealand	920	0.1
Ireland	480	0.1
Albania	132	(1)
Other countries	48,105	6.6
Total	720,355	100.0
Memo:		
Industrialized countries	353,321	49.1
Developing countries	104,608	14.5
EC(12)	116,438	16.2
Nonmarket economy countries[2]	262,426	36.4

[1] Less than 0.1 percent.

[2] Although the economies in a number of these countries are currently undergoing major market-oriented restructuring, they operated as nonmarket economies during 1988.

Source: International Iron and Steel Institute, Steel Statistical Yearbook, 1989.

Table F-5

World exports of semifinished and finished steel, by country, 1988

Country	Exports	Share of total exports	Share produc export
	(1,000 short tons)	(percent)	
Japan	25,688	13.8	22.1
West Germany	22,194	11.8	49.1
Belgium-Luxembourg	15,650	8.3	95.4
France	12,565	6.7	59.7
Brazil	12,033	6.4	44.3
Soviet Union	10,362	5.5	5.8
South Korea	7,707	4.1	36.6
Italy	7,502	4.0	28.8
United Kingdom	7,359	3.9	35.2
Netherlands	6,211	3.3	[2]102.1
German Dem. Rep	5,512	2.9	61.5
Turkey	4,504	2.4	50.7
Czechoslovakia	4,476	2.4	26.4
Spain	4,290	2.3	32.7
Canada	3,998	2.1	23.9
Austria	3,459	1.8	68.8
Romania	3,417	1.8	21.4
Sweden	3,290	1.7	62.5
South Africa	2,919	1.6	30.0
Poland	2,588	1.4	13.9
United States	2,113	1.1	2.1
Yugoslavia	2,070	1.1	41.9
Taiwan	1,818	1.0	19.9
Argentina	1,731	0.9	43.2
Hungary	1,709	0.9	43.3
Finland	1,562	0.8	50.6
Mexico	1,375	0.7	16.0
Switzerland	937	0.5	86.0
Australia	871	0.5	12.3
Norway	741	0.4	73.8
Denmark	608	0.3	84.9
Bulgaria	582	0.3	18.3
Greece	551	0.3	52.1
Ireland	270	0.1	90.4
People's Rep. China	165	0.1	0.3
Portugal	131	0.1	14.9
India	125	0.1	0.8
New Zealand	79	2.0	15.0
Vietnam	[3]	[3]	[3]
Cuba	[3]	[3]	[3]
North Korea	[3]	[3]	[3]
Other countries	4,914	2.6	22.9
Total	188,076	100.0	21.7
Memo:			
Industr'd countries	129,562	68.9	29.7
Develop'g countries	29,703	15.8	27.7
EC (12)	77,331	41.1	51.0
Nonmarket economies[4]	28,811	15.3	9.0

[1] The ratio, which reflects exports of semifinished and finished steel products as a share of raw steel prod is believed to closely represent the ratio that would result from converting semifinished and finished steel expo their raw steel equivalents.

[2] Ratio believed to be overstated as a result of comparing exports of finished products to production of rav

[3] Not available.

[4] Although the economies in a number of these countries are currently undergoing major market-oriented restructuring, they operated as nonmarket economies during 1988.

Source: Compiled from data collected by the International Iron and Steel Institute, Steel Statistical Yearbook

Table F-6

World imports of semi-finished and finished steel, by country, 1988

Country	Imports	Share of total imports	Imports' share of consumption[1]	Trade balance
	1,000 short tons	(percent)	(percent)	1,000 short tons
United States	21,252	11.6	21.3	(19,139)
West Germany	15,526	8.5	46.3	6,668
Soviet Union	11,574	6.3	8.1	(1,212)
France	10,454	5.7	62.4	2,111
People's Rep. China	9,921	5.4	16.1	(9,756)
Italy	9,900	5.4	38.4	(2,398)
Japan	7,701	4.2	8.6	17,987
German Democratic Rep	6,283	3.4	77.1	(771)
Taiwan	5,862	3.2	56.1	(4,044)
United Kingdom	5,758	3.1	35.4	1,601
Belgium-Luxembourg	5,650	3.1	132.5	10,000
Netherlands	5,118	2.8	121.7	1,093
Canada	4,443	2.4	32.2	(445)
South Korea	3,725	2.0	23.3	3,982
Spain	2,971	1.6	29.6	1,319
Bulgaria	2,911	1.6	60.2	(2,329)
Switzerland	2,425	1.3	99.3	1,488
Sweden	2,281	1.2	67.4	1,009
India	2,093	1.1	13.3	(1,968)
Turkey	1,752	1.0	27.2	2,752
Denmark	1,488	0.8	86.1	(880)
Austria	1,451	0.8	57.9	2,008
Poland	1,401	0.8	10.5	1,187
Romania	1,401	0.8	12.7	2,016
Yugoslavia	1,362	0.7	38.8	708
Hungary	1,290	0.7	43.7	419
Norway	1,163	0.6	91.9	(422)
Argentina	1,091	0.6	41.8	641
Portugal	1,041	0.6	63.3	(910)
Australia	992	0.5	15.9	(121)
Greece	879	0.5	48.7	(328)
Finland	780	0.4	39.4	782
Cuba	661	0.4	62.7	[3]
Mexico	621	0.3	9.4	754
Czechoslovakia	564	0.3	6	3,912
New Zealand	536	0.3	58.3	(457)
Ireland	480	0.3	100.0	(210)
South Africa	211	0.1	4.1	2,708
Albania	132	0.1	100.0	[2]
Brazil	123	0.1	1.0	11,910
North Korea	[2]	[2]	[2]	[2]
Vietnam	[2]	[2]	[2]	[2]
Other countries	27,556	15.1	66.6	(22,642)
Total	182,824	100	25.4	[3]
Memo:				
Industrial'd countries	105,614	57.8	29.9	23,948
Developing countries	41,071	22.5	39.3	(11,368)
EC (12)	59,265	32.4	50.9	18,066
Nonmarket economies[4]	36,139	19.8	13.8	(7,328)

[1] Some countries, such as the Netherlands and Belgium-Luxembourg, are such large traders that import volume (much of which is subsequently processed and exported) exceeds consumption.

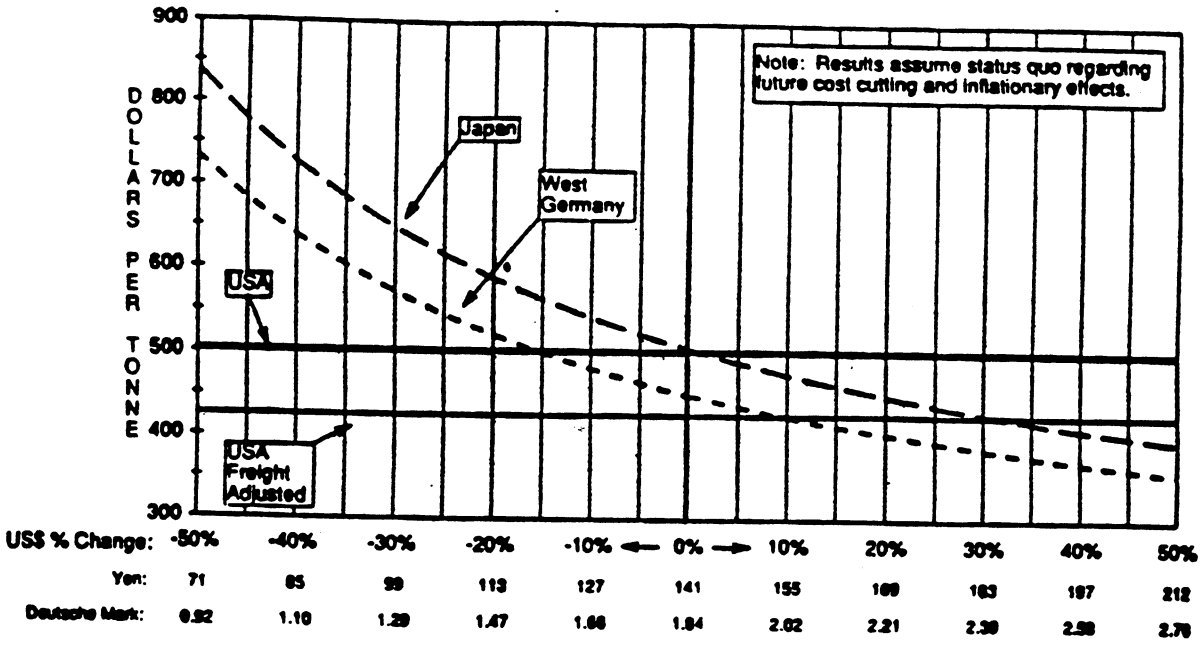
[2] Not available.

[3] Not calculated.

[4] Although the economies in a number of these countries are currently undergoing major market-oriented restructuring, they operated as nonmarket economies during 1988.

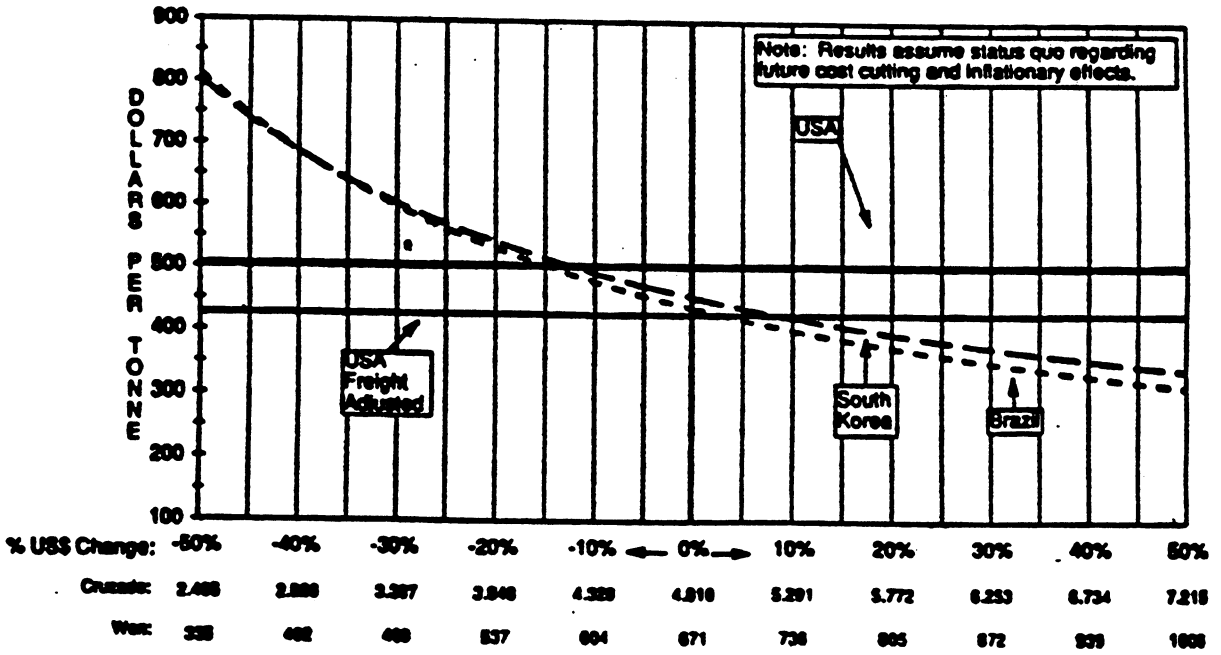
Source: Compiled from data collected by the International Iron and Steel Institute, Steel Statistical Yearbook 1989.

Figure F-1
Pretax cost of West Germany and Japan at various exchange rates: Nov. 1989



Source: World Steel Dynamics, International Steel Cost Monitor.

Figure F-2
Pretax cost of South Korea and Brazil at various exchange rates: Nov. 1989



Source: World Steel Dynamics, International Steel Cost Monitor.

APPENDIX G
DESCRIPTION OF ACTIONS TAKEN BY MAJOR COMPANIES TO MAINTAIN INTERNATIONAL COMPETITIVENES

ARMCO STEEL CO., L.P.

Background

On May 13, 1989, Armco Steel Company, L.P. (ASC) was formed. ASC is a joint venture, limited partnership which is owned by Armco Inc. and Kawasaki Steel Corp. of Japan. At the time of formation, Armco Inc. held a 60-percent share of the company and Kawasaki held a 40-percent share.

With the divestiture of its former Eastern Steel Division into a separate company (ASC), Armco Inc. no longer produces iron, and the steelmaking capacity of its wholly owned subsidiaries is less than 2 million short tons. However, the facilities which form ASC do produce both iron and steel and had a raw steelmaking capacity of approximately 3.5 million short tons in 1988.[1] For this reason, ASC, not Armco Inc., will be treated as a major company in this report.

As of its formation date, ASC comprised three separate facilities, as shown in the following tabulation:

Facility	*Products*	*Ownership*
Middletown, OH	Coated, high strength and low-carbon flat-rolled steels	100%
Ashland, KY	Coated and uncoated flat-rolled products	100%
Hamilton, OH[1]	Pig iron	100%

[1] The Hamilton, OH works supplies the Middletown works with iron and is operated as part of the Middletown works.

ASC's strategic goals are to become a leading supplier of flat-rolled steels in terms of both product quality and productivity by operating state-of-the-art facilities and implementing extensive R&D efforts. The joint venture is committed to the following measures to help achieve these goals:

1. To respond to customer needs for more high quality flat-rolled steel;
2. To accelerate the modernization plan for the division (assisted by Kawasaki's financial and technical support);
3. To increase capacity in the most profitable product lines;
4. To better serve existing customers;
5. To facilitate the transfer of technology from Kawasaki to Armco; and
6. To provide better service to Japanese manufacturers located in the United States.[2]

Efforts Related to Facilities

Changes in Corporate Structure (Formation of Joint Ventures)

As noted above, ASC was formed in May 1989 by Armco Inc. and Kawasaki Steel. The venture's output consists principally of coated and uncoated carbon steel flat-rolled products for the automobile, appliance, construction, manufacturing, distribution and conversion markets. As part of the joint venture agreement, Kawasaki was to contribute $70 million to ASC in May 1990, and an additional $70 million in May 1991. These contributions will increase Kawasaki's interest in ASC from the current 40 percent to 45 percent and 50 percent, respectively. Moreover, Kawasaki will contribute an additional $35 million to ASC in March 1992, which will not increase its ownership interest beyond the 50-percent. ***.

[1] A major company is defined as a company producing both iron and steel, and having raw steel production exceeding 2.0 million tons in 1988.

[2] Armco Inc. press release, "Armco and Kawasaki Steel Announce Joint Venture to Improve Specialty Carbon Steel Operations."

Changes in Operations: Investment in New Equipment

Middletown Works

Currently, ASC's Middletown Works has an annual raw steelmaking capacity of more than 2.2 million tons at a facility that also contains two coke batteries, two blast furnaces, a basic oxygen furnace, a vacuum degasser and ladle refiner, and a twin strand caster. Rolling and finishing operations include a hot-strip mill, two cold-rolling mills, a hot-dip galvanizing line, a hot-dip aluminizing line, an electrogalvanizing line, and a terne coating line.[3] The following investments are being made at Middletown to enable ASC to achieve its business goals:

Type of investment[1]	*Start Date*	*Completion Date*	*Cost ($000,000)*	*Reason for Investment*[2]
Installation of second electrogalvanizing line	1989	1 Q 1991	***	B
Upgrade of the seven finishing stands of the 86-inch hot-strip mill	1989	3 Q 1991	***	C
Expansion of ternecoating line capacity	1989	4 Q 1990	***	B
Expansion of walking beam slab reheat furnace capacity	1989	3 Q 1991	***	B
Cold mill improvements	1989	4 Q 1989	***	
Dinstallation of hot-dip galvanizing line	1990	2 Q 1993	***	B
Improvements to blast furnace stove	1988	3 Q 1990	***	A
Installation of CAS-OB ladle refining system and carbon/temperature probe in melt shop	1988	3 Q 1990	***	D
* * * * * * *				
Upgrade of pickling lines	1990	4 Q 1993	***	C,D

[1] Information from *Iron & Steel Engineer*, "Developments in the Iron and Steel Industry U.S. and Canada—1989", February 1990; *Iron Age*, December 1989; and field visit, ASC, April 19, 1990.

[2] Reasons for investment are coded as follows:

A. Facility maintenance and replacements.
B. Increased capacity.
C. Improvement in operating efficiency.
D. Improvement in quality.
E. Other.

As shown in the above tabulation, several of the projects are expected to result in increased coating capacity, improved product quality, and greater operating efficiency.

Ashland Works

ASC's facility at Ashland, KY, which has an annual raw steelmaking capacity of 1.2 million tons, houses two coke batteries, two blast furnaces, a basic oxygen furnace and ladle refiner, a hot-strip mill, a cold-rolling mill, and two hot-dip galvanizing lines.[4] The following investments are being made at Ashland:

[3] Armco Steel Co., L.P., Performance Brochure, May 1989.
[4] Armco Steel Co., L.P., Performance Brochure, May 1989.

Type of investment[1]	Start Date	Completion Date	Cost ($000,000)	Reason for investment[2]
Conversion of bloom caster to a 1.5 million ton-per-year slab caster	1988	2 Q 1990	***	C
Installation of a 10,000 ton-per-month hydrogen annealing facility	1988	1989	***	B
Upgrade of the 3-stand cold mill	1989	2 Q 1990	***	D
Reline of the blast furnace	1990	2 Q 1992	***	A
Environmental	1988	Ongoing	***	E

[1] Information from *Iron & Steel Engineer*, "Developments in the Iron and Steel Industry U.S. and Canada - 1989", February 1990; *Iron Age*, December 1989; and field visit, ASC, April 19, 1990.

[2] Reasons for investment are coded as follows:

A. Facility maintenance and replacements.
B. Increased capacity.
C. Improvement in operating efficiency.
D. Improvement in quality.
E. Other.

ASC officials indicated that these investments are intended to expand ASC's presence in its current markets and help it to become a world class supplier of flat-rolled steel for the automotive, appliance, and manufacturing industries. In addition, a number of ASC's investment projects are oriented towards improved product quality. For example, the expansion of the continuous caster at the Middletown Works and the completion of a caster at Ashland is expected to increase ASC's continuous casting capacity to at least 75 percent of raw steelmaking capacity, which will improve the steel's metallurgical consistency and yield. The additional walking beam slab re-heat capacity at the Middletown hot-strip mill is intended to provide improved product quality control while controlling manufacturing costs. Cold-rolling mills are expected to achieve state-of-the-art status with the addition of hydraulic gage controls in Middletown and automatic roll changers in Ashland. Coating capacities will be expanded with the addition of a new electrogalvanizing line and hot-dip galvanizing line at Middletown.[5]

Input Costs

Actions Related to Raw Materials

Important raw materials for ASC include iron ore, coal, zinc, aluminum, lime and limestone, ferroalloys, and scrap. ASC reportedly ***.

ASC, at its Ashland, KY plant, uses the only blast furnace coal injection system operating in the United States. The facility, which has employed this technology since 1963, achieves an injection rate of 180 pounds of coal per ton of iron.[6] Company officials noted that the use of coal injection in place of coke means that slightly less total coal [about 8-10 percent] is required to produce a ton of iron. ***.

Actions Related to Labor

In August 1989, the United Steelworkers of America (USWA) approved a 4-year labor contract with Armco Inc. that covers employees at ASC's plant in Ashland, KY, as well as two other Armco Inc. facilities. The USWA contract, which called for an end to a $0.65-per-hour-caster-acquisition concession at Ashland, is patterned after the 4-year labor agreements reached that summer with other major steel producers.[7]

[5] Armco Steel Co., L.P. Performance brochure.
[6] *Iron Age*, "Coal Gets a New Shot," January 1989.
[7] Field visit with Armco Steel Co. on Apr. 19, 1990.

Employees at ASC's Middletown, OH plant are represented by an independent union, the Armco Employee Independent Federation (AEIF). In early March 1990, workers at this plant approved a new 4-year pact containing a no-strike, no-lockout clause effective through 1998.[8] The clause establishes a Customer Assurance Plan (CAP) which is currently unique in the industry. The CAP is designed to provide ASC's customers with a guarantee of a continued source of supply through the termination of the 1994 labor agreement.[9]

In addition to the 8-year CAP provision, the new contract raises hourly wages a total of $1.50 over the life of the pact (including a 75-cent-per-hour raise effective in 1990); increases the incentive base calculation rate by a total of $1 per hour over the course of the contract; creates a profit-sharing plan with annual payments based on the profits of Armco Steel Co.; provides for an "inflation recognition payment," effective August 1, 1991, whereby hourly employees will receive lump-sum quarterly cost-of-living increases any time the cost of living goes up more than 3 percent from the previous year; provides for a $500-per-worker signing bonus and another $500 bonus payable in 1994 under the CAP; and adopts various increases in the workers' pension plan. According to an ASC official, the new labor pact represents "a significant increase" from the former total hourly labor cost of $24.56. Industry analysts have indicated that ASC's Middletown labor rate will likely exceed $30 per hour, similar to the total labor costs of its major competitors.[10]

Research and Development

ASC's research and development expenditures accounted for approximately *** of total industry R&D spending in 1989. Research and development efforts for ASC are performed primarily by Armco Research and Technology, a consolidated corporate research and development laboratory providing product and process development and technical support for all Armco business units. Kawasaki Steel is expected to play a significant role in ASC's R&D activity, given its expertise in flat-rolled steel technology.[11]

In conformance with ASC's business strategy, research work is focused on the development of deep drawing, high strength, and specialty coated sheet steels and more efficient and controllable production processes. These products are aimed primarily at the automotive market and secondarily at the appliance and construction markets. Recent important developments include aluminized stainless steel for automotive exhaust systems, ***.[12]

Market Related Activities

Product/Market Development and Refinement

In recent years, ASC has undertaken certain market-related activities to improve its competitiveness and to facilitate its move into higher value flat-rolled products. ASC officials noted that there is a movement among auto producers toward single-sourcing steel suppliers in order to eliminate variability in material.[13] This trend has been a primary impetus behind many of ASC's market-development efforts, including the following:

* * * * * * *

[8] Approximately 220 Middletown steelworkers were laid off in the first quarter of 1990 after ASC lost orders as a result of a strike threat before the new contract was negotiated in March. (*American Metal Market*, "Armco Eliminating 20% of White Collar Workers", April 2, 1990.)
[9] See *American Metal Market*, "Labor Pact Approved at Armco", Mar. 8, 1990.
[10] Ibid.
[11] Armco Inc. Press Release, "Armco and Kawasaki Steel Announce Joint Venture to Improve Specialty Carbon Steel Operations."
[12] Field visit with Armco Steel Co. on Apr. 19, 1990.
[13] Field visit with Armco Steel Co. on Apr. 19, 1990.

These efforts enabled ASC to be selected as ***.[14]

Actions to Improve Product Quality and Customer Service

To improve product quality during the production process, ASC has implemented the Total Quality System Model (TQS) in its operating units. Under TQS, each production department defines the product quality requirements for the preceding department on the basis of its needs for high-quality material. The sum of each department's quality requirements produces an overall product quality standard for the entire mill.[15]

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Numerous efforts to improve customer service are also being made by ASC; in particular, ASC's customer "partnership" approach was designed to develop closer long-range working relationships with customers from the initial design phase through production of the finished product. To provide more rapid, accurate response to customer inquiries, ASC relies on an electronic data interchange (EDI) system. EDI also facilitates such aspects of customer service as order entry and electronic funds transfer, as well as the tracking of orders.[16] ***.

BETHLEHEM STEEL CORPORATION

Background

Bethlehem Steel Corp. (Bethlehem) is the nation's second-largest steel producer. The corporation is divided into three divisions; basic steel operations, steel-related operations, and raw materials and transportation. Basic steel operations account for over 90 percent of Bethlehem's net sales, which totaled $5.3 billion in 1989. As of January 1, 1989, the corporation operated five steelmaking plants, with a combined annual raw steelmaking capacity of approximately 16 million tons.[17] These facilities and their principal products are as follows:

Facility	*Products*	*Ownership*
Burns Harbor, IN	Hot- & cold-rolled sheet, galvanized sheet, light and heavy plate[18]	100 %
Sparrows Point, MD	Hot- & cold-rolled sheet, galvanized sheet, Galvalume (i.e zinc-aluminum coated) sheet, tin mill products, and semifinished steel	100 %
Bethlehem, PA	Structural shapes, sheet piling, forgings[19] and iron castings	100 %
Steelton, PA	Railroad rails, trackwork, large-diameter pipe, bars, special sections, and semifinished steel	100 %
Johnstown, PA	Bars, wire rod, and wire.[20]	100 %

[14] Ibid.
[15] Ibid.
[16] Field visit with Armco Steel Co. on Apr. 19, 1990.
[17] Shipments of finished steel products in 1989 totaled approximately 9.5 million tons.
[18] Bethlehem also treats coke ovens and a galvanizing line located at Lackawanna, NY as part of its Burn Harbor operation.
[19] Forgings are produced at the Bethlehem facility by the BethForge Division of Bethlehem's Steel-Related Operations group.
[20] The Bar, Rod and Wire Division, headquartered at Johnstown, also operates a bar mill at the Lackawanna, NY, facility and a rod mill at the Sparrows Point, MD plant.

Bethlehem had net income of $246 million in 1989, down from $403 million in 1988. Net income of $406 million in the Basic Steel Operations segment was reduced by losses of $138 million[21] in the Steel-Related Operations segment and $22 million in other areas.

Bethlehem indicates that there are two principles on which their corporate strategy is based: to be a customer-driven, premier producer and supplier of quality steel products, and, to have a sound financial base for meeting the challenges and opportunities of the future.[22]

To do so, Bethlehem appears to have decided to focus on the flat rolled markets as the most important in the company's future, as reflected in the investment being made in quality-enhancing equipment being installed at its two flat rolled facilities (at Sparrows Point and Burns Harbor). The divisions based in Steelton and Johnstown, which produce long products, have been unprofitable and the Bethlehem structural division faces increasing competition from steel minimills, who are expanding their structural steel capabilities. Investment at these three facilities in recent years has been limited and no major investment projects at these facilities have been announced for the future. Further downsizing and restructuring has taken place at the company's various downstream steel-related operations.

Changes in corporate structure

Acquisition/Sales of Existing Facilities

Bethlehem increased its ownership in an existing joint venture, Walbridge Coatings, by agreeing in November to purchase half of Inland Steel Co.'s share of the 400,000 tpy electrogalvanizing facility. Upon completion of the deal, Bethlehem will own 37.5 percent of the facility, Inland will own 12.5 percent, and Pre-Finish Metals, the managing partner, will own 50 percent. Output of the plant is divided between Bethlehem and Inland, and terms of the agreement mean that by 1992 Bethlehem will have rights to 300,000 tons of the facility's production annually.[23]

The company divested two operations from its steel related division in 1989; its Beaumont, TX, shipyard and its Williamsport (PA) Wire Rope Division. These restructuring moves were reportedly undertaken in an effort to increase the company's emphasis on its basic steel operations.

Formation of Joint Ventures

Bethlehem formed a 50-50 joint venture with the Chavanne-Ketin Division of the French steelmaker Usinor-Sacilor to produce cast iron rolling mill rolls at its Bethlehem, PA-based BethForge division. Such rolls are used to produce flat-rolled ferrous and non-ferrous products. Bethlehem will gain technology and expertise for the installation of a centrifugal caster, which will allow production of higher quality rolls. Additional actions to be undertaken in this project include construction of new heat treating facilities and the consolidation of existing heat treating facilities and machine shops. The cost of program has not been announced. The planned renovations to the company's BethForge facilities will take place in 1990 and should have a beneficial effect on costs and quality at Bethlehem's flat-rolled operations (which will use the rolls on existing mills).[24]

Changes in Operations

Investment in New Equipment

In 1989, Bethlehem spent $421 million on plant and equipment at all divisions.[25] Most of the investment was directed to projects within the Basic Steel Operations division.

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[21] Included in this loss is $105 million of unusual charges associated with restructuring and downsizing programs at the company's BethForge and Baltimore Marine Divisions.
[22] Bethlehem Steel Corp., *Annual Report*, 1988.
[23] *Iron and Steelmaker*, November 1989.
[24] *American Metal Market*, Oct. 30, 1989.
[25] Bethlehem Steel Corp., *Annual Report*, 1989.

The company is in the midst of a 5-year capital investment plan scheduled to be completed in 1993. Projected expenditures through that year are about $500 million annually.[26] While the company would like to increase the annual expenditures and accelerate the modernization program, that reportedly limited by capital availability. Major investment projects which were begun, finished, or of an ongoing status during the year are detailed on a plant by plant basis below.

Bethlehem Structural Products Division (Saucon Div.)

April 22, 1989 marked the startup of the Saucon Division's totally new 59 inch wide edger and universal stands, installed as part of a modernization program of the company's Grey mill. The Grey mill is the largest structural mill in the United States. Included in the program were new motors, computer controls, and support facilities. Productivity and quality benefits derived from the modernization program included a reduction in mill rejects, tighter dimensional and weight-per foot tolerences, improved throughput for the mill, and reduced time requirements for roll changes. The modernization program will allow Bethlehem to increase its range of structural section sizes, including some sections now available only from offshore sources.[27] The cost of the program was approximately $50 million. Bethlehem will continue to upgrade its structural production operations and is expected to spend $33 million on those facilities in 1990.[28]

During April and May, 1989 renovations were performed on the facility's "D" blast furnace. The furnace's bell[29] and certain sections of the refractory lining were replaced. The cost of this project was approximately $6 million.

Burns Harbor

During 1989, the major capital spending project at the Burns Harbor plant involved completing construction of a vacuum degasser, which was commissioned in January 1990. The facility, estimated to cost $50 million, will be used to produce low-hydrogen and ultra low-carbon plate and sheet, high-quality products experiencing increasing demand. The ability to produce the low carbon sheet products will have the synergistic effect of extending the range of the continuous annealing line at the facility.[30] Associated work undertaken with this project included modifications to a basic oxygen furnace and the melt shop's configuration.[31]

In early 1989, a $15 million project involving the installation of automatic gauge control (AGC) on the 80-inch cold rolling mill was completed. The new controls will allow tighter tolerances to be achieved on cold rolled and coated sheet products. A follow on project to improve the down coiler on the mill was instituted soon after the AGC program was finished.[32]

Another major project was a $14 million upgrade of the No. 1 continuous slab caster at the plant. The installation of larger (42 ton) tundishes and improved structural, mechanical and peripheral equipment will improve the ability to cast sequential heats without interruption.[33] This will translate into higher quality production, improved yield, and increased productivity for the facility. Continuous casting capability will also be raised by approximately 80,000 tons per year.

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[26] Interviews with Bethlehem personnel indicate that their facilities require capital expenditures of $150 million to $200 million annually just for maintenance purposes. This reduces the available amounts for expenditures on new equipment to $300 million to $350 million per year.

[27] Wilde, William J., "Modernization of Bethlehem's 48-in. heavy structural mill-The Grey mill", *Iron and Steel Engineer*, April, 1990, pp. 56-60.

[28] "Bethlehem resists minis' structural challenge," *Metal Bulletin*, Mar. 22, 1990, pg. 22.

[29] The bell is an apparatus at the top of the furnace that controls the charging of raw materials and the internal working pressure.

[30] "Where Steel's Placing its Capital Dollars", *Iron Age*, September 1989.

[31] "Developments in the Iron and Steel Industry U.S. and Canada-1989," *Iron and Steel Engineer*, February 1990.

[32] Interviews with Bethlehem officials.

[33] "Caster modernized at Bethlehem Plant", *American Metal Market*, May 23, 1989.

Scheduled for completion in 1990 are improvements to the plant's 160-inch plate mill. The mill is being fitted with hydraulic gauge control on the final finishing stand and a new process control computer.[34] These actions will result in some improvement in yield, but the primary goal is improved physical tolerances for plate products.

On March 30, 1989, the company announced that it was embarking on an $8 million program to install pollution control equipment on two of its three Lackawanna, NY, coke batteries.[35] The third battery is scheduled to be closed at the end of 1991, lowering capacity at the facility from 1.1 million tons to 800,000 tons annually. Construction began in the second quarter of 1989 and is scheduled for completion in mid-1990.[36]

The company also announced a $300 million plan to construct three hot-dip galvanizing lines, one of which will be located at the Burns Harbor plant. The facility is designed as a 72-inch wide line aimed at producing a total of 750,000 tons annually of pure zinc (galvanized) and zinc-iron alloy (galvanealed) coated sheet steel. Production from the line will be sold primarily to the automotive industry. Completion is scheduled by 1992.[37]

Sparrows Point

At the Sparrows Point works the major capital project is a $200 million revamp of the plant's 68-inch hot strip mill (HSM). This project, initiated in 1988, will be completed in early 1991.[38] While the program is aimed primarily at quality enhancements, the upgrade will allow the production of significantly larger (1100 pounds per inch of width) coils. Such coils are not only being increasingly demanded in the market, but will lead to productivity and marginal capacity increases as well. The improved capability will also allow more efficient use of the facility's 4-year-old continuous caster (which is also undergoing minor modification), as it will allow a higher casting speed, thus increasing the capacity of the machine. Included in the project is the construction of two new walking beam slab reheat furnaces, a reversing roughing mill, a Stelco coil box and various other ancillary equipment, including digital process controls.[39] The combination of the caster and HSM projects should allow the plant to continuously cast 100 percent of its steel.

During early 1990 the "L" blast furnace at Sparrows Point was fully relined at a cost of approximately $65 million. The plant's smaller "J" and "K" furnaces were brought back into service to supply iron to the plant's BOF during the reline.[40] Startup costs to blow these two furnaces into service is estimated at $10 million.

An agreement with the Maryland Department of the Environment was reached in June, calling for the expenditure of almost $93 million over a 5-year period. Most of the investment will be spent on the coke batteries that had been responsible for $150,000 in environmental noncompliance fines during 1989.[41] Specific actions and investment are as follows:

Cast	*Project*
$40 million	Installation of coke oven gas and chemical cleaning system
$16 million	Installation of Kress Indirect Dry Cooling (KIDC) system to eliminate coke pushing emissions
$24 million	Reconstruction of coke ovens to original specifications
$8 million	Manufacture and installation of new coke oven doors
$5 million	Installation of iron granulation or pigging system for processing of excess molten iron[42]

[34] *Iron and Steel Engineer*, February 1990, p. D-4.

[35] The Lackawanna facility, although operated by the company's BethEnergy division, provides Burns Harbor with coke and responsibility for the for the plant lies ultimately with the general manager of Burns Harbor.

[36] "Bethlehem Coke Units Get Pollution Controls", *American Metal Market*, Apr. 6, 1989.

[37] "Bethlehem Plans $300M Sheet Coating Expansion", *American Metal Market*, July 28, 1989.

[38] Bethlehem Steel Corp., *Annual Report*, 1989.

[39] "Bethlehem in $200M Strip Mill Upgrade", *Metal Bulletin*, Aug. 1, 1988.

[40] The "L" furnace produces roughly 9,000 tons per day, while the combined capacity of the "J" and "K" furnaces is about 6,500 tons per day. The plant accumulated slab inventories prior to the shut down to help offset the shortfall; this enabled the company to maintain higher operating levels on rolling and finishing equipment.

[41] "Bethlehem to Cut Toxic Emissions", *American Metal Market*, June 21, 1989.

[42] "Bethlehem's $40M cleaning system for Sparrows Point said first of kind", *American Metal Market*, June 26, 1989, p..

The oven gas and chemical cleaning system represents new technology and will be partially underwritten by the U.S. Department of Energy under its Clean Coal Technology Program. DOE contributions will total $13.5 million.[43]

As part of the $300 million program to build three hot-dip coating lines, a 48-inch-wide line will be constructed at Sparrows Point. The 260,000 ton-per-year-line will produce both galvanized and Galvalume[44] sheet products. This line will serve to replace some existing production capacity. Output will be aimed at construction and other nonautomotive markets. The company, in conjunction with a joint venture partner, plans to build a twin to this line at an undisclosed southwestern United States location upon completion of the Sparrows Point line.[45]

A $12 million program involving modernization of the #3 tin mill pickling line and the 48-inch cold rolling mill was completed in December. New coil handling equipment fitted to the pickling line will allow processing of larger coils (50,000 lbs.) and will result in the delivery of tighter coils to the tin line.[46] Work on the cold mill involved new coil handling equipment on the entry end to reduce the incidence of damaged coils and new electronic controls throughout the mill.

Johnstown

At the Bar, Rod and Wire Division, the installation of a new ladle reheating facility was completed in early 1990 at a reported cost of somewhat less than $6 million.[47] When used in conjunction with the plant's other ladle metallurgy facilities, the installation should allow the Bethlehem to enter new, high-quality bar markets, including bearing quality steels.[48] Productivity of Johnstown's electric arc furnaces should also be enhanced by this installation.

Plant Closures

The company indefinitely closed the 10-inch rod mill at its Johnstown works in December 1989. Rod production will be consolidated at the firm's Sparrows Point rod mill, yielding higher utilization rates at that facility.[49] It appears unlikely that production will resume at the facility, given the highly competitive conditions in worldwide wire rod markets.

Reduction of input costs

Actions Related to Raw Materials

Bethlehem is improving its ability to alter the mix between captive and purchased coal. Some captive mines have been closed and others have been converted to sales of steam coal as the company reduces its degree of upstream integration.[50] The company has found that purchasing coal allows it to use better grades and better mixes, yielding better coke. The company is also in the early stages of a research project, in conjunction with the U.S. Department of Energy, to test a new system for blast furnace coal injection.[51]

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[43] "Taking Coke Cleanup A Step Further", Iron Age, September 1989.

[44] Galvalume is a proprietary product coated with a zinc aluminum alloy. Galvalume was developed by Bethlehem; however, the rights to the product have been sold to the Australian firm Broken Hill Proprietary (BHP).

[45] "Developments in the Iron and Steel Industry U.S. and Canada 1989", *Iron and Steel Engineer*, February 1990 and "Bethlehem Plans $300m Sheet Coating Expansion," *American Metal Market*, July 28, 1989.

[46] "Production Machinery Picked to Upgrade Bethlehem Facility", *American Metal Market*, Apr. 19, 1989.

[47] Balcerek, Tom, "Bethlehem unit completes ladle reheat station", *American Metal Market*, Jan. 11, 1990.

[48] "Bethlehem Steel installs new ladle reheat station", *Iron Age*, February 1990, p. 10.

[49] "Bethlehem set to idle rod mill at Johnstown", *American Metal Market*, Oct. 17, 1989.

[50] Although some mines have been closed, capital expenditures for remaining coal mining operations have actually increased.

[51] See the "Research and Development" below for more details on this project.

Bethlehem continues to increase its use of fluxed iron ore pellets in their blast furnaces. Such pellets have raised blast furnace capacities and seem to result in longer refractory life.[52]

Actions Related to Labor[53]

In May, well before the July 31, 1989 expiration of their existing labor contract, Bethlehem and the United Steel Workers of America (USWA) reached an agreement on a 50-month labor contract, reflective from June 1, 1989 to July 31, 1993. The agreement provides for the restoration of concessions granted by the union in the previous (1986) labor contract, including an 8.8 percent increase in wages effective June 1, 1989.[54] Wage increases of $1.00 per hour and $.50 per hour are included, effective January 1, 1991 and January 1, 1992, respectively. The contract also includes provisions for adjustments based on inflation, should it exceed 3 percent in any year of the contract. The parties also negotiated a new profit-sharing plan, based on both corporate (6 percent) and divisional (4 percent) pretax profits.[55] Increases in benefits included higher pension and insurance coverage, the staggered return of three holidays, improved supplementary unemployment benefit payments, and increased premiums for Sunday work.

While the initial reaction by industry observers to the contract was that it seemed to be costly, a number of financial analysts viewed the contract as favorable to the company.[56] Aspects of the contract that contribute to that view are the connection of profit sharing to individual divisions, specific clauses that address financially troubled business divisions, and agreement that there is an urgent need to address the subjects of combined and/or expanded trade and craft classifications ("multi-crafting") and revisions to work rules. These latter points should promote greater flexibility in the utilization of the work force, with potentially large improvements in productivity and labor costs. The parties will also establish a joint task force to explore new work systems that will provide advantages to both the company and union members.

Significant to the efforts to establish multicrafting, work rule revisions and new work systems is that the contract requires the cooperation of the company and the union in resolving these issues. The steel industry has a long history of antagonistic relations between management and its workers, and this mandated collaboration may serve to strengthen the movement towards cooperation first evidenced in the hard economic times of the early 1980s.

Bethlehem has already elected to take action under the clause relating to financially troubled divisions in its new labor contract. In March 1990, the company announced that it would seek concessions from the local representing its 3,700 USWA members at its structural steel division. The company is determined to reduce costs at the facility and acknowledged that a tradeoff of investment for labor concessions, primarily labor practices and positions, is a possible strategy.[57]

Throughout the year, Bethlehem made contributions of $359 million to its pension plans. Of this total, $142 million went to reducing the company's unfunded accumulated benefit obligations. As of December 31, 1989, such unfunded obligations stood at $879 million, compared to $1.0 billion at the end of 1988 and $1.6 billion at the end of 1987.[58]

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[52] Discussions with Bethlehem officials.

[53] Except where otherwise noted, information in this section is drawn from documents provided by Bethlehem Steel Corp.

[54] This increase will not have as large effect on Bethlehem's costs, relative to previous years, as it may seem. In the past two years, the company made $3,500 (Mar. 31, 1989) and $2,500 (Mar. 29, 1990) profit sharing payments to each worker as an offset to wage and benefit reductions. Similar payments were also made in 1987 and 1988. The formula for calculating profit sharing payments was altered in the new contract.

[55] Profit sharing payments will be reduced dollar for dollar by any amounts paid under gain sharing plans (productivity based incentives) at the Burns Harbor Division.

[56] For example, see analysis by First Boston Corp, Paine Webber, Goldman Sachs, Salomon Brothers, Inc.

[57] "Bethlehem eyes fix in structurals", *American Metal Market*, Mar. 20, 1990, p. 1,6.

[58] Financial report for the fourth quarter, 1989, Bethlehem Steel Corporation.

Research and Development Activities

Bethlehem employs approximately 350 scientists and engineers in research and development activities (R&D). The bulk of these people (approximately 220) work at the Corporation's Homer Research labs in Bethlehem, PA. Another 130 work at mills at various facilities implementing new processes and equipment. The remainder are assigned to technical support functions, aiding customers in their choice and use of steel products. The primary efforts of Bethlehem's R&D personnel are to make incremental improvements in the cost and quality of current products, as opposed to developing new products. Areas of significant effort are steelmaking, strand casting, and coated sheets. Bethlehem's reported expenditures on R&D accounted for *** percent of total R&D expenditures for the nine major companies.

Bethlehem and the U.S. Department of Energy (Energy) came to an agreement in 1989 that paves the way for the company's Burns Harbor plant to act as a demonstration site for evaluating a granulated coal injection process for blast furnaces. The process, developed by British Steel and Simon Macawber Ltd., offers potentially lower grinding costs than the pulverized coal system currently in use in the United States.[59] The initial goal is to replace natural gas injection with coal; after that is accomplished the coal injection levels will be raised to offset some coke requirements.[60] The project is expected to cost $104 million, with Energy funding about 30 percent of the total.[61] The process is to be fitted to the Burns Harbor blast furnace when it is relined in 1993 or 1994.

The company successfully tested a plasma process for the treatment of electric arc furnace (EAF) dust in conjunction with Tetronics Research and Development Co. during 1989. Two of Bethlehem's plants, Steelton and Johnstown, are electric-furnace-based facilities. Disposal of EAF dust has become a major concern since the Environmental Protection Agency promulgated regulations restricting its use in landfills. The process recovers zinc and lead contained in the dust and yields a nonhazardous slag.[62]

Bethlehem entered into an agreement whereby Air Products and Chemicals, Inc. will market a new technology for reheating molten steel. The technology, named Reactive Element Heating, was developed by Bethlehem as an economical way to heat molten steel that had become too cold to feed into continuous casting machines.

Bethlehem has also entered a joint research and development program with Kobe Steel Co. of Japan, a major producer of steel plate. The program involves a process for direct quenching and rapid cooling of plates on the run out table of rolling mills. This heat treatment process yields superior plate qualities. Performing the process in-line with the rolling step uses residual heat and lowers costs, when compared with conventional heat treatment processes which require reheating of the product. If test results are favorable, Bethlehem will seek to install the necessary equipment on their 160 inch plate mill at the Burns Harbor works.[63]

Work continued at the company's Homer Research Labs on twin roll strip casting technology. This long running research program, which includes participation by Weirton, Inland and Armco, seeks to develop a commercially viable casting machine suitable for casting carbon steels in thickness of less than 0.2 inch.

MARKET RELATED ACTIVITIES

Product Development And Refinement

In conjunction with its partners in the Walbridge Coatings joint venture, the company altered a coating line to produce "Durasteel," an organic coating on a zinc-nickel coating

[59] The system will be able to utilize both granulated and pulverized coal in order to conduct comparison tests on operating parameters and costs.
[60] It is estimated that it will take 250 pounds of coal per ton of iron to replace the current 100 pounds of natural gas per ton. The eventual goal is to inject 400 pounds of coal per ton.
[61] McManus, George J., "Steel's giving coal injection a shot", *Iron Age*, May 1990, p. 34.
[62] "Zinc metal from EAF dust goes commercial", *Metal Bulletin Monthly*, March 1989.
[63] Discussions with Bethlehem officials.

substrate. Durasteel has greater resistance to rust than conventional galvanized steel and strengthens Bethlehem's position in the anticorrosive flat-rolled steel market.

Actions to Improve Customer Service

Bethlehem implemented the use of Statistical Process Control in its operating units in the early 1980's. Through the years, the system has been extended to all manufacturing processes, yielding significant benefits. Bethlehem is now extending the use of the concept to nonproduction areas in an effort to improve nonmanufacturing processes, including management functions. The company hopes to create a "total quality environment" throughout the organization to improve service to customers and shareholders.

Efforts continued at the company to expand an Electronic Data Interchange program (EDI). This system is aimed at electronically linking customers and subcontractors with the company's order tracking computers. The implementation of this system continued in 1989, and by early 1990 the order tracking functions were almost complete, allowing customers real-time information on the status of their order. The benefits of such automated order information have gone beyond those accruing to Bethlehem's customers. The system allows better management control, which has resulted in improvements in on time delivery. At one Bethlehem plant, ontime delivery has increased from 60 percent to 88 percent.[64]

Current efforts to expand EDI are concentrated on simplifying order entry functions so customers can order steel by directly entering Bethlehem's computers. The company's goal is to get the customers that account for 75 percent of their business (25 percent of customers) to be ordering through the EDI system.

At their Bethlehem Structural Division, the company set up a warehousing facility, named Bethbeams, in order to carry an inventory of popular structural products. The facility acts as a depot, giving customers more ready access to common sizes and lengths, thereby reducing lead times.[65] The Bethbeams facility is run in addition to their cut to length shipping facility and allows the company to service more varied customer needs.

INLAND STEEL INDUSTRIES

Background

Inland Steel Industries is the United States' fourth-largest steel producer and its largest steel distributor. Inland's activities are principally conducted by three wholly owned subsidiaries: Inland Steel Co., located in East Chicago, IN; Joseph T. Ryerson and Son, Inc., a service center with 28 facilities located throughout the country; and J.M. Tull Metals Co., Inc., a service center with 18 facilities located in the South. All of Inland's steelmaking activities are located at the Indiana Harbor Works in East Chicago, IN. In addition, hot-rolled coils produced at Indiana Harbor are processed by I/N Tek, a joint venture with Nippon Steel Corp. (Japan) located in New Carlisle, IN. Inland Steel Co.'s production mix is approximately 80-percent flat products (plate, sheets, and strip) and 20-percent bars, structurals, and semifinished steel.

Inland Steel Co. accounts for about 55 percent of Inland Steel Industries' total revenues; distribution accounts for the remainder. During 1989, Inland's steel operations generated revenue of $2.4 billion, which was essentially unchanged from 1988. Operating profits for the steelmaking segment, however, declined by over 40 percent during 1989 to $175 million,[66] reflecting lower market volume and higher raw material and labor costs.

[64] Interviews with Bethlehem officials.
[65] "New structural section facility", *Iron and Steel Engineer*, December 1989.
[66] Inland Steel Industries' 1989 Annual Report.

According to company officials, Inland's principal competitive strategy is to enhance its position in the markets for higher value-added flat and long products. The relatively recent formation of joint ventures and the ongoing modernization of certain facilities located at the Indiana Harbor Works are intended to position Inland as one of the United States' premier manufacturers of cold-rolled and coated coils. Other efforts are aimed at enhancing Inland's position in the markets for special quality, engineered, and alloy bar. The operations of Inland's three steelmaking divisions, responsible for the production of plates, sheet and strip, and bars and structurals, have been separated in order to allow division managers to focus more clearly on the market for their specific product(s). According to company officials, facilities which are either unrelated to steelmaking or incapable of producing internationally competitive products are being sold or closed.[67]

Efforts Related to Facilities

Changes in Corporate Structure

Changes in Ownership

During 1989, the relationship between Inland and Nippon Steel Corp., the largest steel producer in the world, expanded when Nippon Steel became Inland's largest single shareholder by purchasing new issues valued at $185 million. Since 1984, Inland and Nippon have participated in technology exchanges and two joint ventures (see Joint Venture Developments).[68] Inland has indicated that its relationship with Nippon Steel facilitates the company's technological advancement; Nippon reportedly has the steel industry's largest research and development capabilities.[69]

The stock purchase supplied Nippon Steel with 13 percent of Inland's voting shares and the right to appoint a mutually acceptable executive from Nippon to Inland's Board of Directors. Inland placed no restrictions on voting the preferred shares, although Nippon agreed that it would not acquire additional shares prior to the final redemption of the preferred stock or transfer ownership of such shares without Inland's approval. Nippon Steel's purchase was viewed favorably by investors, as Inland indicated it would use the acquired funds to repurchase about 15 percent of its common stock, thereby adding as much as 10 percent to earnings per share. More important, investors noted that the expanded relationship would reinforce Inland's increasingly strong relationship with Japanese automotive transplants, three of which are among Inland's largest clients.[70]

Inland Steel Industrial Products Company

During February 1990, Inland Steel Flat Products Co. reorganized its plate-making operations as a separate business unit and profit center, now called Inland Steel Industrial Products Co. The Industrial Products Co. will market products from Indiana Harbor's No. 4 slabbing mill, 100-inch plate mill, and the 76-inch and 44-inch hot-strip mills. Inland explained the reorganization as an attempt to better serve its customers who consume plate, such as the construction, agricultural equipment, rail, and ship-building industries.[71] The move appears to have evolved naturally from a similar separation of Inland Flat Products and Inland Bar and Structural, which occurred in August 1988.

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[67] Representatives from Inland Steel, interview by USITC staff, Chicago, IL, April 19-20, 1990.
[68] For a more detailed discussion of the relationship between Inland and Nippon Steel, see "Adjusting as Preeminence Slips," *The Washington Post*, Dec. 11, 1989, p. A 1.
[69] Inland Steel Industries, *News release*, Dec. 18, 1989.
[70] PaineWebber, Metal Stock Strategies Update, Dec. 28, 1989.
[71] Mike Beirne, "Inland's plate now separate unit," *American Metal Market*, Feb. 21, 1990, p. 2.

Joint Venture Developments

In September 1989, Inland and Nippon Steel expanded the New Carlisle joint venture to include I/N Kote, a galvanizing facility. Together, I/N Tek and I/N Kote represent a joint venture of approximately $1 billion.

I/N Tek

After production of the facility's first coils in March 1990, Inland and Nippon Steel commissioned I/N Tek, a 60/40 joint venture located in New Carlisle, IN, in April. Described as "the cornerstone of Inland's steel strategy," I/N Tek is the first continuous cold rolling mill to be located in the United States; the only other such mill is located at Nippon Steel's Hirohata Works, near Himeji City, Japan. I/N Tek was constructed at a cost of $525 million ($330 million of which was provided by three Japanese trading companies - Mitsui, Mitsubishi Corp. and Nissho Iwai Corp.),[72] and is expected to produce cold-rolled coils at a rate of 1 million tons per year by the end of 1991.[73] Inland reported that I/N Tek would begin a full 21-turn-per-week schedule in June 1990.[74]

Reportedly implementing the most advanced cold-rolling technology in the world, I/N Tek links five separate cold-rolling operations (pickling, tandem rolling, annealing, temper rolling and inspection) into one continuous process. Linkage of the five operations results in significant quality, time, and yield improvements, while employing about 230 workers, which is reportedly less than half the workers employed in competing mills.[75]

With respect to quality, cold-rolled sheets produced at I/N Tek will meet the highest standards regarding gauge, flatness, surface cleanliness, and texture. These properties are intended to enhance the ability of downstream processors to stamp and otherwise form steel, as processors will not need to account for the different characteristics of steel produced in different batches.[76]

The processing of coils at the new facility will require no more than 90 minutes (and many grades in less than 1 hour), compared to the average of 12 days required to process coils by traditional batch methods. Time-savings principally accrue from the continuous annealing process, which requires 10 minutes instead of the 7 days required in the batch annealing process.[77] In addition, the welding process that attaches hot-rolled coils before they are cold-rolled will permit time-savings, as the facility's operators can roll this steel faster than steel coils joined by conventional welds.

Yields at I/N Tek will reportedly be significantly higher than the industry average because continuous processing reduces handling. At the Hirohata Works, only two-tenths of one percent of the coils processed in the mill are currently damaged.[78]

I/N Kote

In September 1989, Inland and Nippon Steel expanded the New Carlisle joint venture to include I/N Kote, a $450 million facility that will galvanize about 900,000 tons of the cold-rolled sheet produced at Indiana Harbor's No. 3 cold strip mill, located about 55 miles from New Carlisle, and I/N Tek, which is located adjacent to the new venture. Both Inland and Nippon Steel applied $120 million toward the venture, with the balance of investment funds supplied through debt financing. The new facility will apparently employ about 200 workers.[79]

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[72] "Steel Marriage Long in the Engagement," *Financial Times*, Apr. 26, 1990, p. 22.
[73] Inland Steel Industries, *1989 Annual Report*, p. 2.
[74] "Ceremony Marks Steel Revolution for Inland, Nippon," *The Inland Steelmaker*, Apr. 12, 1990, p. 1.
[75] Representative from Inland Steel, interview by USITC staff, Chicago, IL, Apr. 20, 1990.
[76] Representative from Inland Steel, interview by USITC staff, Chicago, IL, Apr. 20, 1990.
[77] John R. Burger, "Indiana Hosts Hirohata Clone," *Metal Bulletin Monthly*, January 1990, p. 57.
[78] Representative from Inland Steel, interview by USITC staff, Chicago, IL, Apr. 20, 1990.
[79] "Adjusting as Preeminence Slips," p. A-18.

Besides increasing the partners' ability to provide galvanized coils to important clients, the principal reason for embarking on the new venture was reportedly to utilize I/N Tek more efficiently. Although faster than the annealing processes at most competing mills,[80] I/N Tek's annealing process is a bottleneck; I/N Tek's continuous annealer operates at a speed of 1,500 feet-per-minute, compared to the 5,000-feet-per-minute capability of the tandem mill.[81] Hot-dip galvanizing performed at I/N Kote will eliminate the need to anneal some of the steel processed at I/N Tek, because the hot-dip galvanizing process anneals steel to a degree that is adequate for many applications. The resulting time-savings at I/N Tek will increase that plant's capacity by about 50 percent, to 1.5 million tons per year.[82]

I/N Kote will consist of one electrogalvanizing line with an annual capacity of 400,000 tons and one hot-dip galvanizing line with an annual capacity of 500,000 tons. Both lines will be equipped to process pure zinc and zinc-alloy coated products used by automotive and appliance producers.[83]

Walbridge Coatings

As a result of the construction of I/N Kote, Inland announced it will reduce its participation in Walbridge Coatings, a zinc-nickel electrogalvanizing joint venture formed in 1988 by Inland (25 percent), Bethlehem Steel Corp. (25 percent), and Pre-Finish Metals, Inc. (50 percent). Inland will sell one-half of its equity (12.5 percent) in Walbridge to Bethlehem when I/N Kote begins operations in 1991. As a result, Inland will receive 25 percent of line time at Walbridge (or about 100,000 tons of electrogalvanized sheet per year).[84]

Changes in Operations

Investment in New Equipment

During 1989, capital expenditures made by Inland Steel Co. increased by 36 percent to $141 million.[85] Inland Flat Products Co. and Inland Bar and Structural Co. invested in facilities in order to improve the quality of high value-added products while simultaneously reducing production costs. Because the markets for structurals and plates appeared less promising, Inland undertook no investment in the facilities used to manufacture these items.[86]

Inland Flat Products Company

Of the six major investment projects for existing facilities initiated or continued by Inland during 1989, five involved the company's flat products division. More specifically, modernization has occurred in facilities which supply I/N Tek with hot-rolled coils. In order to improve productivity and the quality of hot-rolled coils delivered to I/N Tek, Inland Flat Products undertook a $50-million modernization of the company's No. 1 continuous slab caster. The upgrade of the caster, which can now be operated at faster speeds, increased Inland's total slab-casting capacity by 700,000 tons (or 35 percent) per year, to 2.7 million tons. In addition, modernization of the caster, which had not been refurbished since 1972, included the implementation of air-water mist cooling, which improves the surface quality of slabs.[87] Surface cracking is less likely to occur if slabs are cooled by mist rather than immersion.

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[80] Annealing is usually required after cold rolling to restore formability; the cold-rolling process can make steel brittle.

[81] John R. Burger, "Indiana Hosts Hirohata Clone," *Metal Bulletin Monthly*, January 1990, p. 57.

[82] Representative from Inland Steel, interview by USITC staff, Chicago, IL, Apr. 20, 1990.

[83] Inland Steel Industries, *News release*, Sept. 12, 1989.

[84] "Bethlehem sets zinc-nickel coating," *American Metal Market*, Aug. 19, 1988, p. 1; and Inland Steel Industries, *News release*, Sept. 6, 1989.

[85] Inland Steel Industries, 1989 *Annual Report*, p. 38.

[86] Inland Steel Industries, *Inland '90*, p. 4.

[87] Peter Scolieri, "Inland, Weirton up planned upgrades," *American Metal Market*, October 11, 1989, p. 1.

Inland also installed two walking beam slab reheating furnaces at its 80-inch hot strip mill; commercial use of the first began in late 1989 with operations at the second furnace scheduled to have begun during May 1990. The $55 million walking beam furnaces are designed to improve gauge control through more uniform heating and to reduce so-called "skid marks" found in steel reheated by other methods.[88] The 80-inch mill's coiling mechanism was also improved to assure more accurate dimensional control in order to improve product quality after subsequent cold-rolling. In addition, the construction of new railroad loading and shipping facilities was completed at the 80-inch hot-strip mill during 1989.[89] These facilities will be used to transport Indiana Harbor's hot-rolled coils to I/N Tek.[90]

Other significant investment projects at Inland's Flat Products Co. included the installation of a combination caster, which casts both slabs and blooms and thereby improves Inland's ability to react to changing product needs; modernization of the No. 5 galvanizing line, which will improve productivity at Inland's steel operations while reducing manufacturing costs for customers;[91] and replacement of furnace hoods at Inland's No. 4 basic oxygen furnace.[92]

Inland Bar and Structural Company

Inland Bar and Structural Co. continued a 3-year, $100 million modernization program announced shortly after its formation, reportedly investing about half of the capital authorized to improve its bar-making facilities during 1989. In general, modernization was undertaken to improve the tolerances, mechanical properties, surface, and straightness of bars produced by the company, which desires to maintain its position as one of the country's principal suppliers of the special quality bars used by the automotive, heavy equipment, forging, and grinding rod industries.[93]

Inland has indicated that installation of a $10-million ladle metallurgy station began at its No. 1 electric furnace shop in October 1989. This station, which will be operational in 1990, increases the division's ladle treatment capability from 35 percent to 100 percent.[94] Ladle treatment, which can include a variety of processes, improves the metallurgical properties of steel while also increasing the capacity of a work's primary refining furnaces. Steelmakers can recharge these furnaces while final treatment of molten steel occurs in the ladle. Inland's ladle furnace will reportedly be equipped for reheating, argon stirring, and alloy addition.[95]

In addition, to improve the metallurgical and surface properties of Inland's bar products, the company's billet caster is being refurbished with electromagnetic stirring, mold and tundish level control, a tangent straightener, new withdrawal units, and submerged casting. Furthermore, the billet caster will be linked to computerized data processing equipment for on-line monitoring.[96]

Inland's 12-inch and 21-inch bar mills will also be improved. During 1989-90, the 12-inch bar mill was upgraded to roll product to tighter specifications and equipped with new billet and bar inspection and cleaning equipment. During 1991, the 21-inch bar mill will be equipped with new electrical equipment for tension-controlled rolling and new cooling beds. Improvements in the 21-inch bar mill will allow Inland to compete in the market for large-sized bars, where Inland has not been an effective competitor in the past.[97]

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[88] Mike Beirne, "Inland Readies Second Walking Beam Furnace," *American Metal Market*, May 15, 1990, p. 4.
[89] Inland Steel Industries, *1989 Annual Report*, p. 7.
[90] John R. Burger, "Indiana hosts Hirohata clone," *Metal Bulletin Monthly*, January 1990, p. 56.
[91] Inland Steel Industries, *News release*, Apr. 11, 1989.
[92] Inland Steel Industries, *1989 Annual Report*, p. 12.
[93] For a more detailed discussion of the special quality bar market, refer to *Monthly Report on the Status of the Steel Industry*, Investigation No. 332 226, United States International Trade Commission, September 1989.
[94] "Inland Bar plans $100M upgrade," *American Metal Market*, Apr. 11, 1989, p. 1.
[95] "Ladle Metallurgy: The Hotbed of Steelmaking," *Iron Age*, August 1989, p. 20.
[96] "Inland Bar plans $100M upgrade."
[97] "Inland Bar plans $100M upgrade," and "Bar Mills: Moving Up the Value Added Ladder," *Iron Age*, February 1989, p. 22.

Coke Facilities

In December 1989, Inland announced that it would install a LO-CATR coke oven gas desulfurization system by 1991. The system will be installed at Inland's No. 2 coke plant in order to desulfurize coke oven gases and reduce sulfur dioxide emissions. Inland will reportedly be the first steel company to use this technology for coke oven gas desulfurization.[98]

Input Costs

Actions Related to Raw Materials

Consistent with Inland's strategy of discontinuing all nonsteel-related businesses, the company closed and indicated interest in selling Inland Lime and Stone Co. during 1989. The company division provided 1.2 million tons of limestone during 1989, which accounted for 99 percent of Inland's limestone consumption. Inland officials indicated that they expect the facility to be sold during 1990. After its sale, the facility is expected to be Inland's sole supplier of metallurgical stone. Currently, Inland purchases lime on the spot market.[99]

During 1989, Inland's three principal sources of iron ore reportedly operated at full capacity. Wholly owned Minorca Mine produced 2.7 million tons of fluxed pellets, whereas jointly owned Empire Mine and Wabush Mine provided a combined total of 4.2 million tons of fluxed pellets. These three mines accounted for 100 percent of Inland's iron ore consumption during 1989, an increase from 85 percent during 1988. Inland is currently in the process of acquiring the Laurentian Reserve iron ore body in order to replace Minorca when that mine's ore reserves are exhausted in 1992. Iron ore mined at the Laurentian Reserve will be processed at the Minorca processing plant.[100]

During 1989, Inland reduced consumption of electrical energy by 1.5 percent as a result of increased use of lower cost natural gas and conservation efforts. Energy consumption per shipped ton of steel decreased by 4 percent from 26.3 British Thermal Units (BTUs) during 1988 to 25.3 BTUs during 1989.[101]

Actions Related to Labor

During 1989, the integrated steel segment's workforce was reduced by 2 percent, to 14,865 employees.[102] Total employment costs increased by 2 percent, to $964 million, however, as group insurance costs increased by nearly 20 percent, to $110 million.[103] The bargaining unit averaged about 4.1 man hours per-ton-shipped during 1989, which was essentially unchanged from 1988.[104]

In June 1989, Inland reached an agreement with the USWA, representing 11,350 workers at the company's Indiana Harbor Works. The agreement, which was ratified on July 14, 1989, covers a 4-year period from August 1, 1989 to July 31, 1993. Workers will receive a $1.50 wage increase over the 4 years covered by the contract. The past agreement's COLA was replaced by a lump-sum payment called the Inflation Recognition Payment, which will be made quarterly during the 3d and 4th years of the contract if living costs inflate more than a specified percentage. The agreement also included a $500 bonus, an extra week of vacation during one of the next 4 years, and the enhancement of pension plans offered by Inland.[105]

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[98] Inland Steel Industries, *News release*, Dec. 29, 1989.
[99] Representative of Inland Steel, interviewed by USITC staff, Chicago, IL, Apr. 19, 1990.
[100] Inland Steel Industries, *1989 Annual Report*, pp. 7-8, and 14.
[101] Inland Steel Industries' 1989 Annual Report, p. 8.
[102] Inland Steel Industries' 1989 Annual Report, p. 15.
[103] These figures pertain to Inland Steel Industries' total workforce, which exceeds 20,000 workers. However, new health benefits won by the bargaining unit, combined with the increased cost of health benefits, apparently account for most of the increase in total health costs.
[104] Inland Steel Industries' 1989 Annual Report, p. 25.
[105] Inland Steel Industries, *News release*, June 23, 1989.

The new labor agreement also provides for Inland's participation in the Career Development Institute at a cost of $175,000 per year. The institute will fund certain educational programs, as yet undefined, which will train workers for positions both inside and outside of the steel industry.[106]

Research and Development

Inland's research and development unit focuses on creating new steel products and manufacturing processes, providing technical direction for strategic planning, and contributing to the solution of customer problems. ***.[107]

Inland has been successful in marketing both processes and products recently developed in its research laboratories. In March 1989, Inland and Mitsubishi International Corp. reached an agreement to supply Inland's aluminized steel technology to Korea's Pohang Coated Steel Co. (POCOS). Aluminized steel is a heat-resistant product used primarily for automotive exhaust components like mufflers, exhaust pipes, and tail pipes. It competes with, and is less expensive than, stainless steel.

The licensing agreement stems from recent contacts between Inland and Mitsubishi, during which Mitsubishi became familiar with Inland's process for making aluminized steel. The agreement contains a provision that prohibits sales of POCOS's aluminized steel product in the United States until 1993 and significantly restricts such sales until 1998.[108]

Among the newly developed products marketed by Inland during 1989 were magnetic steels, which have applications in electron and proton accelerators, and free-machining and microalloyed bars, which are stronger, lighter, and less costly bars with automotive applications. Inland also commercially introduced an automotive subassembly of bar and sheet steel designed as a protective door beam during 1989.[109]

Market Related Activities

Market Development and Refinement

During the past 2 years, Inland's marketing efforts have been refocused around strategic accounts with a relatively small number of large customers, concentrated in the automotive, appliance, electric motor, and office furniture industries. During 1989, the number of Inland's strategic accounts more than tripled, to 18 such accounts. ***.[110]

With respect to strategic customers, Inland's goal is to maintain contact with individuals responsible for determining which materials will be purchased, such as product planners, engineers, and presourcers. In so doing, the company attempts to sell its expertise in steel and collect information concerning the future needs of these consumers. Inland officials believe that if future consumer demand can be accurately anticipated, the company can prioritize its capital expenditures and production schedules in such a manner as to have the right material available at the right time. Such close relationships would reportedly help to insulate Inland from lost sales due to an inability to meet customer demands in a timely manner.[111]

LTV STEEL COMPANY

Background

LTV Steel Company (LTV) is a subsidiary of LTV Corporation, located in Dallas, TX. In 1989, the corporation had total sales of $6.4 billion, with sales of $4.1 billion in

[106] Representative from Inland Steel, interview by USITC staff, Chicago, IL, Apr. 19, 1990.
[107] Representative from Inland Steel, interview by USITC staff, Chicago, IL, Apr. 19, 1990.
[108] Inland Steel Industries, *News release*, Mar. 2, 1989.
[109] Inland Steel Industries, *1989 Annual Report*, p. 12.
[110] Representative from Inland Steel, interview by USITC staff, Chicago, IL, Apr. 20, 1990.
[111] Representative from Inland Steel, interview by USITC staff, Chicago, IL, Apr. 20, 1990.

steel (64 percent), $673 million in aircraft parts (11 percent), $1.4 billion in missiles and electronics (21 percent), and $268 million in energy products (4 percent). LTV Steel Company had a net operating income of $310 million in 1989, which compares with a net operating income of $423.3 million for the calendar year of 1988.[112]

According to company officials, LTV's competitive strategy is to focus on the production of the high value-added flat rolled and tubular steel products; currently, 85 percent of its shipments consists of flat rolled products. The company intends to produce a new generation of high value-added engineered products by investing in facilities and equipment which increase product quality and productivity while reducing production costs.

As of January 1, 1989, LTV Steel Company maintained a number of facilities producing steel mill products. These facilities and their respective product lines were as follows:[113]

Facility	*Products*	*Ownership*
Aliquippa, PA	Tin mill products	100%
Beaver Falls, OH	Cold finished bars	100%
Canton, OH	Steel bars, high strength and nickel base steels	100%
Cedar Springs, GA.	Steel tubing	100%
Chicago, Ill plant	Bar, wire, and coke	100%
Cleveland, OH	Semifinished steel, hot and cold strip products, electroplated strip	100%
Cleveland, OH	Electrogalvanized sheets	60%[1]
Cleveland, OH	Steel tubing	100%
Columbus, OH	Electrogalvanized sheets	50%[2]
Counce, TN	Pipe	100%
Detroit, MI	Steel tubing and conduit	100%
East Chicago, Ind.	Sheet and strip products and galvanized sheet	100%
Elyria, OH	Steel tubing	100%
Gary, IN	Cold finished bars	100%
Hennepin, IL	Cold rolled and coated products	100%
Massilon, OH	Hot and cold finished steel bars	100%
Pittsburgh, PA	Coke	100%
Warren, OH	Coke	100%
Williamantic, CT	Cold finished bars	100%
Youngstown, OH	Pipe	100%

[1] Sumitomo Metal Industries, Ltd. Tokyo owns 40 percent.
[2] Sumitomo Metal Industries, Ltd. Tokyo owns 50 percent.

Efforts Related to Facilities

Changes in Corporate Structure

Acquisition and sales of existing facilities

In November 1989, LTV Corporation concluded the sale of the LTV Steel Bar Division, consisting of nine plants with a combined annual production capacity of 1.2 million tons, to Republic Engineered Steels, Inc. a new Employee Stock Ownership Plan (ESOP) company. The sale of the bar division was one of the terms of LTV's chapter 11 reorganization plan approved by a New York bankruptcy court judge in June 1989. The sale of the bar division will allow LTV to concentrate company resources in the flat-rolled and tubular products business.[114]

[112] The LTV Corporation, *News release*, 89-7 and 90-3, and 1984 10-K Report.
[113] Association of Iron and Steel Engineers, *Directory Iron and Steel Plants*, 1989.
[114] The LTV Corporation, News Release, 89 25, and *American Metal Market*, May 31, 1989, pp. 1 and 8.

In early 1989, LTV Steel Company sold a steel tube plant in Brooklyn, NY, to Brooklyn Steel and Tube Corp. The new company was formed to operate the 72-year-old facility, which LTV closed in April 1988. The plant manufactures carbon steel tubing for a range of hydraulic fluid applications.[115]

Formation of joint ventures

In May 1989, LTV Steel Company and Sumitomo Metal Industries, LTD. (Japan) announced the formation of a second joint venture to produce corrosion resistant steel sheet. The new company, L-S II Electro-Galvanizing Company will be located in Columbus, OH; the first joint venture, L-S I Electro-Galvanizing Company, is located in Cleveland, OH. The new plant, which is scheduled for completion by 1991, will produce over 360,000 tons of zinc and zinc/nickel coated steel. The total cost for the facility, which will employ about 100 workers, is estimated to be in excess of $200 million. Electrogalvanized steel is particularly valued by auto makers because of its corrosion resistance and uniform coating; by producing electrogalvanized steel, LTV hopes to strengthen its position in automotive markets.[116]

Changes in Operations

Investment in New Equipment

LTV has undertaken numerous projects to modernize its facilities. During 1986-89 the company spent approximately $1 billion, about $356 million of which was spent in the latter half of this period. An additional $350 million is expected to be spent in 1990, a total that does not include funds committed to finance the new L-S II Electro-Galvanizing Company joint venture facility described above.[117] Major capital investment projects which were active during 1989 were as follows.

Cleveland Works

A modernization program for the 84-inch hot strip mill included the installation of a new computer control system, various new gauges, and roll-bending equipment. The new control systems are designed to minimize product variations by automatically taking into account factors such as temperature, roll wear, grade variation, and thickness variation. These systems have the on-line adaptive capacity to assure consistency of the process and product. Equipment was installed throughout 1989 and the mill was restarted in February 1990.[118]

Modernization of the works' tandem cold-rolling mill included installation of new gauge control equipment, software models, and in-line process adjustment controls. Most of the work was completed during 1988, but the mill was restarted during 1989.[119]

In 1989 the Cleveland C-6 blast furnace received a reline along with furnace redesign up-grades. The relined furnace is expected to have a longer life and permit more consistent operation. Included in the program is a new automation system which optimizes the ironmaking process and improves fuel efficiency.[120] In addition, the C-5 blast furnace will be significantly upgraded during 1990. When the project is completed, the furnace will contain modern systems which, as in the C-6 blast furnace, are expected to increase the campaign life[121] of the furnace, improve reliability, and thereby reduce ironmaking costs.[122]

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[116] Industrial Relations Department, Brooklyn Steel and Tube Corporation.
[116] *33 Metal Producing*, January 1989, p. 8; The LTV Corporation, News Release, 89-95 and 89-115.
[117] LTV Law Department, letter to U.S. International Trade Commission, Feb. 23, 1990.
[118] Ibid.
[119] Ibid.
[120] Ibid.
[121] Campaign life is the time which elapses between major furnace relinings, averaging 5 to 8 years in the United States.
[122] LTV Law Department.

In early 1989, LTV Steel began construction of a continuous annealing line and a vacuum decarburization facility as part of the modernization plan for its Cleveland complex. The vacuum decarburization facility and the continuous annealing line will enable the company to produce a new generation of ultra-low carbon steel products demanded by automotive, appliance, and electrical equipment manufacturers. The ultralow carbon steel improves the formability of sheets at a lesser cost. The vacuum decarburization facility and the continuous annealing line are scheduled to begin operations in 1991. The total cost of constructing these facilities is estimated at over $250 million.[123]

New sublances have been and are being installed in the basic oxygen furnaces. This equipment will improve steelmaking processes, reduce costs, improve steel quality, and expand production capacity.[124]

Indiana Harbor Works

Construction of a vacuum degasser began in 1988 and the unit became operational at the Indiana Harbor Works in 1989. This equipment permits LTV Steel to produce new steel products of high quality, with ultralow carbon levels and new chemistries. The addition of the vacuum degasser will also allow LTV to develop and produce new steels for applications in the electrical equipment and machinery industry.[125]

A modernization program for the works 84-inch hot strip mill will focus on improving physical specifications. A new computer control system will supervise upgraded mechanical and electrical systems, yielding tighter tolerences for sheet width, thickness and shape. A similar program is underway at the work's 84-inch cold reduction mill. Most of the work is scheduled to be performed during 1990. This equipment will be similar to that installed at the Cleveland hot strip mill and tandem mill. LTV expects these new systems to enable the production of higher quality products.[126]

During 1989, LTV Steel developed improved tin plate products for drawn and ironed tin cans. This was achieved through improvements in instrumentation, more effective control of the annealing lines, and other facility upgrades.[127] Finally, a major modification to the No. 2 galvanizing line was made to improve the facility's efficiency during 1988-89.[128]

Hennepin Works

Modernized shape meters and controls were installed in 1989 on the Hennepin Temper Mill. This equipment will improve the uniform thickness of steel sheets produced at this facility.[129]

Youngstown Works

During 1989, LTV initiated a program to realign the ERW pipe mill to improve its efficiency. This action will not only improve productivity but will also reduce costs.[130]

Actions related to raw materials

In order to reduce costs, LTV is trying different blending formulas, using coals from various sources. These new blends are also expected to improve coke quality and prolong the life of coke batteries. Improved coke quality and consistency combined with alternate blast furnace fuels have reduced the cost of molten iron.[131]

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[123] *Automation*, August 1989, p. 45-46; and the LTV Corporation News Release, 89-63.
[124] Ibid.
[125] Ibid.
[126] Ibid.
[127] Ibid.
[128] LTV Law Department.
[129] Ibid.
[130] Ibid.
[131] Ibid.

Modifications to the design of the company's shaft pellet furnaces located at Hoyt Lake, MN, are being completed in 1990. These modifications will permit production of high-quality fluxed pellets, which will enhance blast furnace operation.[132]

Actions related to labor

The U.S. Supreme Court, on June 18, 1990, upheld the Pension Benefit Guaranty Corporation's (PBGC) authority to protect the Federal Insurance program from abuse and to restore responsibility to LTV for three pension plans underfunded by approximately $2.5 billion. The PBGC will begin immediately to work with LTV to return the responsibility for the pension plans, which cover 60,000 LTV retirees and 40,000 workers.[133]

Labor Management Participation Teams, initiated in 1988, have grown significantly. These teams meet regularly to determine how to improve working conditions and the operation of facilities to best meet customer requirements. LTV Steel continues to expand Labor Management Participation Teams at all company facilities. In 1989, 12 teams were trained, and 10 teams are scheduled for training in 1990. Presently over 25 percent of company employees are actively involved in identifying and solving quality, productivity, and customer-related problems.[134]

The new L-S II Electro Galvanizing Company will be manned using similar work systems to those already in place at L-S I Electro Galvanizing Company. The entire work force, including both union and non-union personnel, will be salaried. The work system provides for broad employee job responsibilities with compensation based on performance. Participation in operational decision making involves the entire work force. The plant is expected to have fewer job classes and employees will be cross-trained for all tasks within the plant.[135]

On April 2, 1989, the 12,855 USWA members at 13 LTV Steel Company locations approved a new labor agreement. The contract's effective date is April 15, 1990, and it expires on August 1, 1993, or when LTV Corporation emerges from chapter 11 bankruptcy, whichever occurs first. The agreement was also approved by the U.S. Bankruptcy Court. Pension issues are subject to current ongoing negotiations between LTV and the PBGC.[136]

The labor agreement restored wages to former levels and and provided for increased hourly wages ($1.50) and incentive rates. The Sunday premium was increased to time and a half, and three holidays and 3 weeks vacation were also restored. Other benefits extended to workers were profit sharing, a $1,000 ratification bonus, and inflation payments which will increase wages by the inflation rate minus 3 percent. The agreement also includes the stipulation that the company will absorb certain scheduled increases in health care costs.

With the current Agreement, LTV Steel joined other major steel companies in a new venture known as the Career Development Program. The Program provides training and personnel development of the entire workforce. LTV will contribute $210,000 per month, beginning in May 1990 to the program.[137]

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[132] Ibid.

[133] LTV Steel, Departmental Correspondence *Supreme Court Decision*, June 18, 1990 and Pension Benefit Guaranty Corporation, News, *Supreme Court Decision Vindicates PBGC*, June 18, 1990.

[134] LTV Law Department.

[135] Ibid.

[136] Although the Supreme Court has decided to restore responsibility to LTV for the pension funds, it has also instructed the PBGC to work with LTV in order to resolve certain issues between the creditors, banks, and the PBGC.

[137] United Steelworkers of America, "United Steelworkers of America and LTV Steel Corp.: Summary of Proposed agreement," March 1990, ratified by USWA members on Apr. 2, 1990.

RESEARCH AND DEVELOPMENT ACTIVITIES

LTV has several projects underway in conjunction with steel coil coaters to develop new and improved prepainted steel techniques which will improve the quality of this kind of material.[138] Coil coated steel, a high-value product, can potentially reduce costs to end users.

LTV is also participating in the effort to develop a direct steelmaking process. This pilot project is jointly sponsored by AISI and the Department of Energy. This major research project is directed toward substantially reducing the energy used in producing steel, improving the environment, and reducing both capital and operating costs. Commercial applications of the technology are estimated to be 10 years away.[139]

MARKET RELATED ACTIVITIES

Actions to improve product quality and customer service

In July 1989, LTV opened a Customer Technical Center (CTC), in Independence, OH. The CTC is designed to help customers use steel more efficiently by simulating the types of forming, joining, and coating operations that take place in the customers' manufacturing plants. The staff is trained to determine the best steel for customers specific applications. Modern test facilities are available to examine problems related to welding, corrosion, adhesive bonding, and paint and coating applications. The 24,000-square-foot CTC and its specialized staff are intended to assist customers' from the product design stage, through prototypes, to full-scale manufacturing.[140]

LTV Steel, in conjunction with IQS, Inc., announced in July 1989 the development of a computerized Gage Responsibility and Reproducibility, or "Gage R&R," program. It is designed to improve product quality assurance methods used by LTV, its customers, and suppliers. The package, including a Measurement Device System (MDS), software, and user manual, will aid in calculating and tracking gage variations throughout the production process.[141]

NATIONAL STEEL CORPORATION

Background

National Steel Corporation (National) was the nation's sixth-largest steelmaker in 1989. Its principal steel products are hot- and cold-rolled, galvanized and other coated sheet and strip products and tin mill products. Most of these products are of carbon steel grades, but National also produces a full line of high strength, low alloy steels.

National was reconfigured in 1984 when National Intergroup, Inc. (NII) sold 50 percent of the steelmaking division to NKK Corporation (NKK) of Japan. Currently, NKK owns a 70-percent share of National and NII owns 30 percent. The company is headquartered in Pittsburgh and employs approximately 12,200 people.

As of January 1, 1989, National had ownership interests in three major steel production facilities and two affiliated steel processors. The location, product lines and ownership are detailed below.

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[138] LTV Law Department.
[139] Telephone conversation with AISI project scientist, April 16, 1990.
[140] Ibid.
[141] The LTV Corporation, News Release, 89 14.

Division and Location	Products	Ownership
Great Lakes Division Ecorse, MI	Sheet and strip (hot and cold rolled), plate, electrogalvanized sheet	100%
Granite City Division Granite City, IL	Sheet and strip (hot and cold rolled), plate, high strength products, galvanized coated products	100%
Midwest Division Portage, IN	Tin plate, galvanized and coated products, electrical lamination steels, cold rolled sheet	100%
American Steel Corp. Detroit, MI	Steel processor	100%
ProColl Canton, MI	Steel processor	44%

In 1989, the company shipped nearly 5 million tons of steel. The automotive industry remained the company's largest end market in 1989, followed by the service center, construction, and industrial and electrical equipment markets. The breakdown by end markets has remained relatively constant since 1985 (table 1). The construction and certain small niche-oriented markets grew the fastest in 1989, whereas the drop off was the greatest in the automotive market.

Capacity utilization of National's basic steel-producing facilities was relatively high (96.7 percent, as compared to 84.1 percent for the entire industry) in 1989, as it had been in 1987 and 1988. This reflects an imbalance between raw steelmaking and rolling capacity at the company. In order to improve utilization of its hot strip mills, National had to purchase slabs on the open market.[142] According to company officials, the imbalance is likely to remain in the foreseeable future.

National's recorded profits of $83.2 million on sales of $2.6 billion in 1989 represented a decrease from 1988, when profits reached $88.2 million on similar sales levels.[143] Reasons given for the reduced profits include the softness of the auto market, lost orders resulting from the initial rejection of the new labor contract, higher purchased material costs, and higher labor costs associated with the new agreement[144] Company officials also pointed out that because National has a relatively large portion of its business in the auto market where purchases are made by contract, it was not able to take advantage of the spot market prices, which in 1989 were reportedly higher than prices in the contract market.[145]

National's overall corporate strategy appears to be to improve its competitive position by raising the company's standards of product quality (especially for high-value added products) and customer service (with a focus on the automotive market). Unlike many of its competitors in the integrated sector, National produces flat-rolled products exclusively, allowing it to more narrowly focus its capital expenditures.

[142] National Steel Corp., *Form 10-K*, 1989, p. 5.
[143] National Steel, News Release, Jan. 24, 1990.
[144] National Steel Corp., *Form 10-K*, 1989, p. 18.
[145] Interview with National officials, Mar. 16, 1990.

Table G-1

National's shipments by market, 1985-89

(Percent)

End Market	1989	1988	1987	1986	1985
Automotive	28	31	29	29	29
Service centers	23	23	25	27	28
Construction	14	13	11	11	13
Industrial and electrical equipment	15	16	16	14	(1)
Containers	12	11	11	12	11
All other markets	8	6	6	7	(1)

[1] Not available.

Source: National Steel, *1989 Year-End Report*.

Changes in Corporate Structure

Changes in Ownership

On April 25, 1990, NII and NKK announced that their Boards of Directors had approved an agreement in principle under which NII would sell an additional 20-percent ownership of National to NKK for approximately $147 million. Under the terms of the agreement, NII will pay the proceeds from the equity sale to National in return for National's assuming $147 million worth of Weirton liabilities.[146] The agreement contains a preferred stock provision that will allow NII to reduce its holdings in National to 20 percent in 1995 and 10 percent in 2000.

Previously, NII had refused to accept a minority partnership position and had sought complete divestiture instead. However, NKK was not interested in 100-percent ownership and there was apparently insufficient interest from third parties in purchasing NII's interest.

If the transaction proceeds as agreed, NKK will be the Japanese company with the largest percentage equity investment in a major U.S. steel company. NKK has emphasized that the agreement would not lead to any changes in management policies and that the company would continue to be managed like an "American company."[147]

Formation of Joint Ventures

National is considering a joint venture with NKK and Dofasco of Canada to build a hot-dip galvanizing line. Under the tentative agreement, Dofasco would own 50 percent of the company, NKK *** percent and National *** percent. According to current plans, the 72-inch, 400,000-tons-per-year facility would be modeled after one of the galvanizing lines at NKK's Fukayama works, helping to minimize design and construction time. Reportedly, the line, which could be operational as early as January 1992, would serve as a toll coater for the owners.[148] U.S., Canadian and Japanese transplant auto manufacturers would be the main customers for the proposed joint venture, ***.[149]

Changes in Operations

Investment in New Equipment

Shortly after the formation of the NKK/NII joint venture in 1984, National Steel initiated a 10-year, $1.8 billion capital expansion and modernization program. By the end of the first phase of the modernization program in September 1988, over $800 million had been invested in several projects, including a second continuous caster, a ladle metallurgy facility, and an electrolytic galvanizing line at the Great Lakes Division; and an additional ladle metallurgy system and renovations of the hot strip mill at the Granite City Division.

Phase II of the modernization program was announced in September, 1988. It committed National to spend an additional $1 billion over the course of 5 years. National spent about a quarter of that allocated sum in 1989.[150] The figure for 1990 is reported to be $210 million.[151]

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[146] National Intergroup, Inc., News Release, April 25, 1990. When National sold its Weirton Steel Division in 1984, NII assumed responsibility for certain pension liabilities. The proposed equity sale would transfer a portion of the responsibility for those liabilities to National.

[147] National Intergroup, Inc., news release, Apr. 25, 1990.

[148] *Iron Age*, September, 1989, pp. 38-39. A "toll coater" is a company that coats cold-rolled coils from other companies as a value-added operation.

[149] Interview with National officials, March 16, 1990.

[150] Interview with National officials, March 16, 1990.

[151] *Iron Age*, September 1989, p. 40.

In 1989, National's modernization program focused on two main projects: the installation of a vacuum-degassing facility at the Great Lakes Division and the introduction of a second continuous caster at the Granite City Division. The installation of this caster will allow National to become the first major U.S. steelmaker to reach 100-percent continuous casting (from 89-percent in 1989).[152] Previous modernization efforts had already allowed the Great Lakes Division, the only other division of the company that casts steel, to cast all of its steel production.

Following is a description of the major projects undertaken by the company in 1989, by division.

Great Lakes Division

National began phase II of its modernization program with the announcement of the installation of an RH vacuum degasser at the Great Lakes Division. The $70 million degasser, which began operation in February 1990, serves three functions.[153] First, it increases the productivity and capacity of steelmaking operations by allowing them to operate more smoothly and efficiently. National officials are hoping to increase by 25 percent the number of heats per day, to between 41 to 43.[154] Second, it increases the life of the BOF refractory by reducing oxygen blowing times in the BOFs. Third, and most importantly, it improves the quality of the steel. Vacuum degassing permits the production of ultralow carbon steel (in this case as low as 0.005 percent),[155] which is increasingly demanded by automotive customers. It permits auto manufacturers to use thinner gauge steel, thereby reducing the overall weight of the vehicle. At the same time, it may reduce the chances of denting, providing cost savings to the manufacturer. Ultralow carbon steel also offers benefits to steel furniture and appliance manufacturers, who use such steels for electrical applications. Mitsubishi International and Marubeni America, the general contractors for the project, worked in conjunction with Davy McKee Corporation (through its Davy Dravo Division), to build and install the new degasser.[156] In February 1990, National borrowed $56.4 million, to be repaid over the next 10 years, to finance the purchase of the vacuum degasser facility.[157]

In addition to installing the vacuum degasser, National is relining its D blast furnace and upgrading its hot strip mill, tandem mill, and galvanizing line. At the hot strip mill, phase I of a modernization program to improve quality and process efficiency began in 1989 and is scheduled for completion in 1991. Electric and hydraulic automatic gauge control (AGC) will be added to improve surface flatness, and work roll bending controls will be installed to improve shape control. Computer/setup controls for the finisher will be added together with a crop shear, and the loopers, runout table and downcoilers will be upgraded.[158] The projected cost of phase I work is $36 million.[159]

At the tandem cold-rolling mill, roll-bending capability is scheduled to be added by the second quarter of 1990 to four of the five stands.[160] Other improvements to the tandem mill, scheduled for completion in 1992, will bring the total cost of the upgrade to $4.5 million. The upgrade will improve shape control and productivity, as well as decrease mill rejects.[161]

Granite City Division

In May 1990, the galvanizing line anodes were converted from 50-percent soluble/50 percent insoluble to 100 percent insoluble. National officials anticipate that this will

[152] National Steel Corp., *Form 10-K*, 1989, p. 5.
[153] National Steel, News release, Sept. 28, 1988.
[154] Interview with National officials, Mar. 16, 1990.
[155] *Iron Age*, May 1990, p. 33.
[156] National Steel, News release, Sept. 28, 1988.
[157] National Steel Corp., *Form 10-K*, 1989, p. 20.
[158] *Iron and Steel Engineer*, February 1990, pp. D-5, D-12. Also, *Iron Age*, September 1989, p. 40.
[159] Information provided by National official, May 22, 1990.
[160] *Iron and Steel Engineer*, February 1990, pp. D 5, D 12. Also, *Iron Age*, September 1989, p. 40.
[161] Information provided by National official, May 22, 1990.

increase the line's productivity, decrease manpower and material requirements, and increase the line's annual capacity by about 40 percent.[162] In addition, the line will be modified by November 1990 to allow National to provide zinc-nickel plating.[163]

The $70 million reline of D blast furnace, scheduled for completion in 1991, will include improved emission controls and the installation of computerized process controls, to increase productivity.[164] In 1989, $3 million was spent for preliminary engineering work.[165]

National Steel announced in early 1989 that it would install a second continuous caster at the Granite City works. The $140 million, single strand caster is scheduled to come on line at that facility by late 1990 or early 1991.[166] Because the mold can vary in width from 35 to 80.4 inches, it will allow National to cast its full product line at Granite City. Its annual capacity will be 1.6 million tons.[167]

The caster is expected not only to increase productivity, but to improve the internal and surface quality of steel. The large-radius, curved-mold design is apparently well suited for high carbon, higher alloy steels since there is less bending and therefore less cracking of the cast slab.[168]

As was the case with the vacuum degasser construction, the major contractors for the construction of the caster, which began in 1989, are Mitsubishi and Marubeni. The two Japanese companies also provided the financing. Sumitomo Heavy Industries and Davy McKee will work in conjunction with the main contractors. The caster will be constructed on a "turnkey" basis, and upon completion, it will be either purchased by, or leased to, a subsidiary of National Steel.[169]

In addition the new caster, there are a couple of other modernization projects underway at the Granite City Division. In the first quarter of 1989, the A blast furnace was relined at a total cost of $39 million. In addition to serving as a general maintenance project to ensure continued efficient operation of the furnace, the reline incorporated changes to improve hot metal quality, decrease operating costs, and reduce coke consumption.[170]

At the cold mill, improved shape and gauge controls will be installed by August 1990. Preparation for the shutdown associated with the upgrade began in 1989. Costing $6.5 million, the upgrade is expected to result in decreased mill delays and decreased yield loss.[171]

A new slab consolidation and handling facility will allow all slabs from the old and the new caster to be handled in a single location. This, combined with the slab quality improvements that come with continuous casting, would potentially increase the percentage of slabs that can be hot-charged, thereby reducing energy costs. National officials pointed out, however, that the Granite City layout is not conducive to this process, and that it would continue to be employed on a limited basis. They estimated that hot-charging saves approximately $10/ton.[172]

Despite the modernization efforts at Granite City, company officials noted that the division still needs further upgrading. Although Granite City reportedly has been able to maintain its competitiveness, they acknowledged that the equipment there, especially in the finishing area, is relatively old. In order to meet the new higher standards, as those likely to be set by I/N Tek and I/N Kote (see company write-up on Inland Steel), National officials see a need to upgrade the facility's tandem mill and galvanizing lines.[173]

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[162] Interview with National officials, Mar. 16, 1990.
[163] *Iron and Steel Engineer*, February 1990, pp. D-5, D-12.
[164] Information provided by National official, May 22, 1990. Also, *Iron and Steel Engineer*, February 1990, pp. D-5, D-12.
[165] Information provided by National official, May 22, 1990.
[166] Interview with National officials, March 16, 1990.
[167] *Iron Age*, August 1989, p. 25.
[168] National Steel, News release, Jan. 11, 1990.
[169] National Steel, News release, Jan. 10, 1989.
[170] Information provided by National official, May 22, 1990.
[171] Information provided by National official, May 22, 1990.
[172] Interview with National officials, Mar. 16, 1990.
[173] Interview with National officials, March 16, 1990.

Midwest Division

Cold-rolling mills, both galvanizing lines, and a pickle line were all upgraded in 1989 at the Midwest Division. At the 80-inch cold mill, hydraulic screws and AGC are schedule to be installed by December 1990 and a 5-stand shapemeter will be added by mid-1990. As a result of the $5.8 million upgrade, shape and gauge will be improved, productivity at downstream units increased, and secondary losses decreased.[174]

The 52-inch cold mill upgrade includes the addition of an entry X-ray gauge, hydraulic AGC at one stand, and new speed regulators. The $6 million project, to be completed by late 1990, will reduce head and tail off-gauge, and improve cold-rolled sheet quality, especially in terms of physical tolerances.

National plans a multiphased project to improve capacity and quality at its 72-inch galvanizing line. Phase I, projected to cost $15 million, began in 1989 and is scheduled for completion in late 1991. Increased productivity (from shorter coating cooling periods) and improved quality (in the form of more even coating weights and a finer spangled product) are expected to result from the upgrade.

In late 1989, the pickling line welder was renovated and the bath was converted from sulfuric acid to a hydrochloric acid. As a result of the $12 million project, productivity and yield increased, and environmental problems associated with the recycling or disposal of spent pickling acid were reduced.[175]

Plant/Equipment Closures

National decreased its reliance on scrap when it shut down its two Great Lakes electric furnaces (EAFs) in June 1989. With the three blast furnaces operating at that division, the company can reportedly meet its steelmaking requirements without relying on the EAFs. Although the EAFs are idle, company officials added that they could be reactivated within 30-day's notice, should conditions warrants such an action. National officials noted several factors in their decision to shut down their EAFs: the low quality of available scrap (an input for electric furnaces); high electricity costs; problems associated with interfacing BOF and EAF steel; and the recent classification of EAF dust as a toxic waste, making disposal costly.[176]

National closed down its sinter plant at the Great Lakes division in 1988, and as a result began to rely exclusively on pellets in 1989. National officials cited economic as well as environmental reasons for the sinter plant shutdown.[177]

In 1989, National shut down its Beaver Creek Mining operation of National Mines, primarily for cost reasons. As a result, National had to purchase more coal on the market at higher prices.[178] Although ongoing negotiations between National Mines and the United Mineworkers have not been successful to this point, it is possible that if an agreement is reached, the operation would reopen.

Input Costs

Actions Related to Raw Materials

The company's coke situation is apparently one of its greatest areas of concern. The problem became more critical in 1986 when National shut down its largest battery at Great Lakes, mainly due to difficulties in complying with environmental regulations. Currently, the company is only 40-percent self-sufficient in coke.[179]

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[174] Information provided by National official, May 22, 1990.
[175] Information provide by National official, May 22, 1990. Also, *Iron and Steel Engineer*, February 1990, p. D-5, D-12.
[176] Interview with National officials, Mar. 16, 1990.
[177] Interview with National officials, Mar. 16, 1990.
[178] Interview with National official, May 14, 1990.

In August 1989, National approached contractors regarding the reconstruction of its No. 5 coke battery at the Great Lakes Division. This is a project which National had considered several times over the past decade in order to decrease its reliance on outside purchases of coke.[180] With current coke prices high and the problems associated with the company's coke facilities, National is considering the project more seriously. If it proceeds with the project (which has yet to be approved), the company would increase its coke self-sufficiency to approximately 75 percent by 1993-94. Estimates for the cost of the rebuild range from $100 million to $200 million.

A factor in the pending battery rebuild decision is the impact of certain proposed amendments to the Clean Air Act. National anticipates that the cost of coke on the market will increase, as several batteries will be forced to shut down if some of the proposed changes are adopted.

Company officials have considered the benefits of installing coal injection on their blast furnaces, but do not consider it to be economical at this time. In their cost-benefit analysis, the savings achieved through coal injection technology do not outweigh the cost of the pulverizing equipment.[181]

The exclusive reliance on pellets resulting from the 1988 shutdown of the sinter plant at Great Lakes has not forced National to purchase iron ore on the open market. In fact, in 1989 iron ore and pellets available to National from its subsidiary, National Steel Pellet Co., and its affiliated Iron Ore Co. of Canada were in excess of needs. National expects to continue to be "long" on iron ore and pellets for the foreseeable future.[182]

In order to assure an independent supply of natural gas, the Great Lakes Division arranged for a direct linkup with a long-distance pipeline in 1989. Previously, the division relied on a local utility company. National officials expect the change to save $7 million annually in energy costs.[183]

Actions Related to Labor

National and the United Steel Workers of America (USWA) reached a new 50-month labor agreement on July 14, 1989, the same day that the union reached an agreement with Inland management. The contract, which terminates on August 1, 1993, parallels the one reached at Bethlehem Steel earlier in 1989. According to National management, the negotiations focused less on wage increases and more on work rules (e.g. the contracting out of labor, weekend work) and other issues specific to National.[184]

Like the Bethlehem contract, the National contract calls for a $1.50 per hour wage increase over the life of the agreement, averaging a $1-per-hour increase in 1990 and a $0.50-per-hour increase in 1992. To bring wages back up to their 1986 levels, the contract provided for an immediate wage restoration for production and maintenance workers ($0.31 per hour) and for clerical workers ($0.42 per hour) retroactive to June 1, 1989. In addition, the contract includes the restoration of time-and-one-half for Sundays, health care benefits improvements, improved pensions for future retirees, modified profit-sharing and productivity/gain-sharing plans (under which employees earned $15.5 million and $9.8 million, respectively, in 1989), and inflation recognitions payments (which increase hourly wage 1 percent for each percentage point that inflation exceeds 3 percent in a given year, starting in 1991).[185]

Although the contract was approved overwhelmingly in the union vote (5,373 to 778), there was some dissatisfaction on the part of National's rank and file with USWA's leadership. Workers at the smaller Midwest Division voted to approve the first version of the contract, which was rejected in the overall vote (of all three divisions). In an

[180] Interview with National officials, Mar. 16, 1990.
[181] *Iron Age*, September 1989, p. 46.
[182] Interview with National officials, March 16, 1990.
[183] National Steel Corporation, *Form 10-K*, 1989, p. 6.
[184] National Steel, *Year End Report 1989*, p. 24.
[185] Interview with National officials, Mar. 16, 1990.
[186] National Steel, *Year-End Report 1989*, p. 12.

apparent attempt to avoid a potential strike, they petitioned for a new vote.[186] Within a month, however, the revised contract had already been approved. The revisions were reportedly minor, involving quicker cost-of-living adjustment payments and the right to choose between a $500 cash advance or an equivalent investment in a 401(k) retirement plan. Before the second vote, National estimated that a rejection of the contract would cost the company 300,000 tons of third-quarter business.[187]

***.[188]

Labor productivity improved 4 percent between 1988 and 1989, as the number of manhours per ton of steel shipped dropped to 4.61 hours; company officials indicated they had expected more improvement, ***.[189]

Research and Development Activities

Research and development efforts at National were characterized by company officials as customer oriented and short- or medium-term in nature.[190] The company employs *** researchers, *** of whom work at the Howard M. Love Technical Research Center (TRC). The multimillion-dollar facility, near Detroit, focuses on applied research for process and product improvements.[191] National also employs *** researchers at its product applications center, also near Detroit, where staff provide product and technical support to customers. The remaining *** researchers work in technical service positions. ***. For the past 5 years, total expenditures for research and development represented less than 1 percent of net sales.[192]

Market Related Activities

Product/Market Development and Refinement

National is focusing its product/marketing development and refinement efforts on its automotive clients. Of the $800 million spent in phase I of the capital modernization plan, for example, nearly 80 percent went towards improvements in the Great Lakes Division, half of whose shipments go to auto makers or their suppliers.[193]

National's joint ventures further demonstrate its commitment to the automotive market. In 1988, National joined with the Marubeni Corporation of Japan to form ProCoil, a first stage processing operation located near Detroit and targeted for the auto market. The $20 million project was financed by Marubeni, which also offered technical assistance. The Great Lakes and Midwest divisions of National supply ProCoil with unprocessed steel and also handle all of ProCoil's sales and marketing. ProCoil, which delivers its slit steel annually on a "just-in-time" basis, allows automotive customers to reduce, and often eliminate, the expense of maintaining costly processing facilities.[194]

The proposed hot-dip galvanizing joint venture also demonstrates National's commitment to the automotive industry, as most of its production is targeted to that market.

In addition, National is making an attempt to increase its share of business with the Japanese auto companies producing in he United States. The company already supplies Toyota, Mazda, and Diamond-Star.[195]

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[186] *Iron Age*, May 1990, p. 33.
[187] *American Metal Market*, July 6, 1989, p. 2.
[188] *American Metal Market*, June 22, 1989, p. 2.
[189] Interview with National officials, March 16, 1990.
[190] Interview with National officials, Mar. 16, 1990.
[191] Interview with National officials, Mar. 16, 1990.
[192] National Steel, News Release, May 16, 1988. Also, Interview with National officials, Mar. 16, 1990.
[193] National Steel Corporation, *Form 10-K*, 1989, p. 8.
[194] National Steel, News release, Jan. 13, 1988. Also, *Iron Age*, May 1990, p. 33.
[195] National Steel Corp., *Annual Report 1988*, pp. 16 18.

Actions to Improve Customer Service

To improve customer service, National continued its "Partners in Performance" program, in which suppliers are systematically evaluated based upon previously agreed upon performance criteria. By forming such an alliance with its suppliers, National expects them to become more consistent and competitive, which in turn will allow National to better meet the level of performance required by its customers. In addition, to improve production, inventory, and delivery management, National introduced the National Integrated Customer Service program in 1989. Company officials expect this program to assist in responding to customers' needs for order information and just-in-time delivery.[196]

National's customer oriented research and development effort at its Product Application Center is also part of its marketing strategy. Staff at the Center work directly with National Steel's customers in their design and manufacturing process.[197] This is increasingly becoming an area where steel companies try to establish themselves as suppliers by working with selected customers in helping to identify and develop specific product needs.

ROUGE STEEL COMPANY

Background

Recently sold by Ford Motor Co., Rouge Steel Co., located in Dearborn, MI is a single-facility, integrated steelmaker whose products are carbon steel slabs, hot- and cold-rolled sheets, and electrogalvanized steels.[198] Production and shipments during 1989 were 2.9 million tons and 2.5 million tons, respectively. In terms of shipments, Rouge is the eighth-largest steel company in the United States.[199] Rouge operates both basic oxygen furnaces (BOF) and electric arc furnaces (EAF) with a total combined capacity of 3.2 million short tons per year,[200] and continuously casts 60 to 70 percent of its production.[201] The facility is apparently well balanced in terms of its production, rolling, and finishing capacities, although the company reportedly wishes to increase the amount of production that is continuously cast. Raw materials used in steelmaking, such as iron ore and coke, are sourced through joint ventures and purchased on the open market; Rouge shut down its coke ovens in 1987.

In close physical proximity to its integrated steelmaking and rolling operations, Rouge and the USS Division of USX Corp. jointly operate an electrogalvanizing line, called Double Eagle Steel Coating Co., a 50-50 joint venture established in 1986.

Activities of Rouge Steel, which were combined with Ford-New Holland (a tractor manufacturer), and Ford Aerospace in Ford's financial statements together accounted for less than 7 percent of total sales of Ford Motor Co. ($6.0 billion), and less than 3 percent of operating income ($179 million), for Ford in 1989.[202] The company was reportedly profitable for the first time in a decade in 1988.[203] Data compiled by the Commission in its questionnaire indicate that total net sales were *** and net income before taxes totaled *** during calendar year in 1989.

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[196] National Steel, *Year-End Report 1989*, p. 17.
[197] National Steel, News release, May 16, 1988.
[198] *Iron and Steel Works of the World, 1988* (9th Edition), Metal Bulletin Books Ltd: Surrey, England, 1987, p. 543.
[199] Tom Balcerek, "Top nine US steelmakers' 1989 profits decline 24%," *American Metal Market*, Feb. 9, 1990, p. 1.
[200] World Steel Dynamics, *Steel Strategist #16* (Dec. 1989,) p. 105. The steelmaking department consists of two-250 ton BOFs with an annual capacity of 2.3 million tons, and two-225 ton EAFs with an annual capacity of 900,000 tons.
[201] A Mannesman Demag/Hitachi Zosen continous slab caster with a capacity of 1.8 million tons was installed in 1986, which improved yields, product uniformity, and steel quality, and resulted in energy savings.
[202] Ford Motor Co., Annual Report on Form 10-K for the Calendar Year Ending Dec. 31, 1988, p. 41.
[203] Mary Beth Dougherty, "Rouge Steel is out of the Red," *Iron Age*, October 1988, p. 31.

Changes in Corporate Structure

Changes in Ownership

As of December 15, 1989, Ford sold the majority of its interest in Rouge Steel Co. to Marico Acquisition Corp., which itself was subsequently merged into Rouge Steel.[204] As part of the conditions of the sale, Ford retained a 20-percent interest in Rouge.[205] Moreover, there are certain linkages between Ford and Rouge that will continue during a two-to-three year period of transition; for example, Ford will continue to provide certain legal and accounting services on Rouge's behalf. Marico was partly owned by Worthington Industries and the Chase Manhattan Bank, which therefore also have a financial interest in the steelmaker.

The bulk of Rouge's production of hot- and cold-rolled sheet has traditionally represented captive consumption of Rouge's corporate parent, Ford,[206] with between 75 and 80 percent of Rouge's production being shipped to the automobile industry.[207] As part of the sales agreement, Ford reportedly committed itself to purchase 40 percent of its U.S. and Canadian steel requirements from Rouge for the next 10 years, virtually the same rate as today for automotive flat-rolled steel.[208] This would imply annual shipments of 960,000 tons of steel out of total shipments of 2.4 million tons. Rouge also has signed a 7-year, long-term supply agreement with Worthington. This agreement, and the intention by Rouge to diversify its marketing efforts, should allow the steelmaker to increase its shipments of sheet to the consumer appliance and office furniture markets.

Investment in New Equipment

A facility improvement program with a capital cost of $105 million was initiated in 1988 and set for completion in 1990.[209] The program was aimed at boosting the quality (particularly the gage and chemistry) of the company's product and the productivity of its steelmaking operations.[210]

The construction of a new $33 million ladle metallurgy facility was completed in late 1989. The station will include electric arc reheating and vacuum-degassing equipment. This facility will reportedly improve final steel chemistry, provide better metallurgical consistency, and improve the drawing qualities of steel treated at the facility.[211]

Advanced computerized controls were installed on the hot strip mill that will reduce the variability in the gauge of Rouge's products. This improvement program is expected to cost approximately $17 million, with a scheduled completion date in July 1990. The company also invested in a new computer system to control and monitor the three walking beam slab reheat furnaces that support the hot strip mill.[212]

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[204] Ford Motor Co., Form 8 K, Feb. 15, 1990, note 3 to Financial Statements. Ford's financial reports with the Securities and Exchange Commission indicate that the rationale for the sale was to allow Ford to increase substantially its capital spending for the core business of automotive operations from recent historical levels; the sale of Rouge helped Ford's cash flow. See, Form 10-Q, Ford Motor Co., for the quarter ended Sept. 30, 1989, note 5 to Consolidated Income Statement, p. 11.

[205] Ford Motor Co., Form 8-K, Feb. 15, 1990, note 3 to the Consolidated Income Statement for the year ended Dec. 31, 1989.

[206] Ford Motor Co., Annual Report on Form 10-K, Calendar Year ending December 31, 1988, "Chairman's Statement", p. 1.

[207] "Ford seeks buyer for Rouge Steel," *Metal Bulletin*, May 22, 1989, p. 19.

[208] Peter Scolieri, "Ford considering sale of Rouge Steel division," *American Metal Market*, Oct. 16, 1989, p. 8.

[209] Ford Motor Co., Annual Report on Form 10-K, for the calendar year ending Dec. 31, 1988.

[210] This and the description that follows is based on *Iron Age*, Octber 1988, p. 32. The investments made during 1989-90 are in many respects a continuation of programs focusing on improving products and modernizing process technology begun during 1986-88; the capital costs associated with the installation of a continuous caster (which improved steel yields and reduced energy costs) accounted for the bulk of $200 million expended during that time period.

[211] This reportedly will allow Rouge to maintain competitiveness in making the ultralow carbon, low sulfur steel being used in the auto industry. The automakers, including Ford, are involving their suppliers sooner in the design process and reducing the number to qualified suppliers as well as part of their efforts to maintain quality control and competitiveness vis-a-vis imports. See also, "Rouge Steel sets diversification plan," *Metal Bulletin*, Feb. 19, 1990, p. 22.

[212] Charles J. Labee and Norman L. Samways, "Developments in the Iron and Steel Industry U.S. and Canada-1989," *Iron and Steel Engineer*, Feb. 1990, pp. D-5 and D-17.

In the cold rolling area, $22 million was spent on new hydrogen annealing equipment and improvements to the cold reduction mill. On the cold mill, enhanced coil-processing equipment and automatic work roll change cars were added, which should improve productivity. The investment in annealing facilities will improve the drawing quality and chemistry of the steel as well as reduce process cycle times. Additional investment in the cold processing area included tension leveling equipment, aimed at improving the quality (flatness) of appliance grade sheet and refurbishing the pickle line.

Additional investment was made in upstream facilities. A full reline of the "B" blast furnace involved adding two new stoves as well as replacing the furnace's refractory lining. In the company's powerhouse operation the coal-fired boiler was converted to natural gas, which is expected to reduce operating costs.

As part of the agreement reached with workers, Marico/Rouge made a commitment to the United Auto Workers (the union representing Rouge's workforce) to invest up to $60 million per year in equipment modernization for 3 years, and to maintain the facility's operations as an integrated steel mill.[213]

Input Costs

Actions Related to Raw Materials

During 1990, Rouge completed the sale of its 10 ships that transported iron ore through the Great Lakes to its facility in Dearborn, and now contracts for transportation services. This should eliminate capital expenditures required to maintain an aging fleet and take advantage of lower-cost freight rates. The company shut down its coke ovens in 1987, and continues to purchase its requirements for coke on the open market. This reduces the company's expenditures for maintaining coke ovens and pollution control. ***.

Rouge began "hot-charging"[214] in 1988-89; during 1989 about *** of continous cast slabs were "hot-charged" into the hot-strip mill. "Hot-charging" results in savings in energy, labor, and handling costs due to its continuous nature.

Actions Related to Labor

Prior to the sale of Rouge, a new labor agreement was signed between Ford and the United Auto Workers. These agreements protected worker seniority at Rouge by providing transfer opportunities to Ford locations, and stipulated that Ford would assume the majority of the current and future pension obligations of the Rouge work-force as of the data of the sale.[215] The then-current Rouge UAW work force's pensions were to be increased to the level of that of the Ford work-force. All Rouge steelworkers were also eligible for special Retention Payments payable by Ford in two installments, the first of which was to be made in December 1989, consisting of up to $6,000 per employee ($600 per year up to 10 years length of service), while the second installment of up to $7,000 per employee, would be made in Dec. 1993, on the third anniversary of the sale of Rouge. Provisions also called for payments of $550 per employee to be made during 1990 and 1991. Effective with the date of the sale, workers assigned to the powerhouse (electrical plant and boilerhouse) were transfered to Ford's employment rolls.

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[213] "Summary of Proposed Extension and Improvement of the UAW-Rouge Steel Co. Agreement-1989- 1992," United Auto Workers, December 1989.

[214] The term "hot charging" should not be confused with "direct charging." During "hot-charging", a continuous cast slab is allowed to cool to between 600 to 750 degrees Farengheit and then transfered to the hot-strip mill. An intermediate step, that of transfering the slab to a soaking pit where it is heated for a certain period of time, is eliminated because the chemistry of the raw steel and its microstructure were fine-tuned at the ladle metallurgy station (a step prior to the continuous caster).

[215] "Summary of Proposed Extension and Improvement of the UAW-Rouge Steel Co. Agreement-1989- 1992," UAW, December 1989.

Reportedly, Rouge's labor costs are among the highest in the steel industry.[216] However, average employee costs, currently *** to *** per hour, including health benefits and pension accruals have been reduced through the assumption by Ford of a significant portion of current and future pension obligations; the elimination of crew size and scheduling restrictions; and ***.

The United Auto Workers (UAW) played a significant role in the sale of Rouge. According to company officials, greater worker involvement in the running and operations of the mill is being translated into increased productivity, an emphasis on quality control, and a closer management-labor relationship. Those employees who chose to remain at Rouge (or who returned to Rouge) are apparently more motivated to make the reconstituted mill profitable. The company has provided new training, which includes hands-on training in statistical process control (and quantitative evaluative measures), the use of special quality representatives among work force teams, and greater information on production and productivity so that hourly employees are fully informed of the costs of operations and rejections at each step of the production process. The focus of labor-management relations is to develop a shared philosophy about ongoing quality improvements.

Research and Development Activities

Rouge spent *** on research and development in 1989, which represents *** and *** of total capital expenditures and total net sales, respectively.

Like many other U.S. steel companies, Rouge participates in joint research programs through the American Iron and Steel Institute, the National Institute of Standards and Technology, the U.S. Department of Energy, the Advanced Steel Processing and Products Research Center at the Colorado School of Mines, and several other State universities (see discussion under "Research and Development"). Such cooperative research projects include studies of new and improved refractories, the chemical and physical properties of coatings on sheet and plate steels, advanced sensor technologies and process controls, near to net shape casting, and direct steelmaking. These programs are long term in nature and process related.

Actions to Improve Customer Service

Rouge has made efforts to improve order reporting methods. There is no online order inquiry system as yet, although Rouge is able to preadvise its customers by computer (electronic data interchange) as to when a shipment has left the mill. The system does not currently provide up-to-date information and delays result from manual reporting that continues to be done for steel shipped outside the plant for processing.

Market Development and Refinement

Rouge has been actively involved in electrogalvanizing activities through its joint venture with the USS Division of USX Corp., Double Eagle Steel Coating Co., which zinc-coats flat-rolled steel for the production of unexposed panels on autos and trucks.[217]

New products, or rather markets other than the automobile industry, have gradually become more important for Rouge. The percentage of production that was shipped to the automobile industry has declined from 90-95 percent to about 75 percent.[218] Rouge now supplies flat-rolled product for the container and tubing markets, construction, appliance, office furniture, as well as to re-rollers and service centers. Although not a sought-after market, Rouge exported hot-rolled coils ***.

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[216] World Steel Dynamics, *Steel Strategist #16*, December 1989, p. 105.

[217] Bryan Berry, "Galvanizing Puts on New Coats," *Iron Age*, September 1989, p. 61. Ford continues to use pure zinc electrogalvanized coatings, but is actively investigating zinc-nickel and organic coatings and has formed ventures to gain experience with zinc nickel, "Durasteel" (Nissan's term for zinc nickel coated organically on one side), and zincroplex (an organic coating) alloys.

UNITED STATES STEEL (USS)

Background

USS, the steel division of USX Corporation, is the largest domestic steelmaker, with an estimated annual raw steel capacity of 19 million tons; in 1989, USS accounted for about 17 percent of total domestic raw steel production. An estimated 70 percent of USS domestic sales are sheet products.[219]

According to company officials, the division's long-term modernization strategy is based on the goal of retaining market share for product lines in which the company can remain competitive. Application of this strategy resulted in $365 million in modernization expenditures in 1989, a 7 percent increase from the previous year.[220] Net sales of the steel sector in 1989 were about $5.7 billion or thirty percent of combined sales for all USX operations; operating profits were $430 million, down 17 percent from 1988.[221]

USS participates in operations at 10 domestic locations, 6 of which are fully integrated steel works capable of processing basic raw materials such as iron ore, into finished mill products. The remaining four facilities process semifinished steel, sheets and tube rounds into coated and tubular products. Total employment for the division at the end of 1989 was 23,750. The facilities and their respective product lines were as follows:

Facility Locations	*Products*	*Ownership*
Gary, IN.	Sheet, tin mill, plate	100%
Fairfield, AL	Sheet, tin mill, tubular	100%
Fairless Hills, PA.	Sheet, tin mill, tubular	100%
Lorain, OH	Tubular products and bars	[222]50%
Chicago, IL	Plate and structurals	100%
Mon Valley, PA	Sheet and strip	100%
Pittsburg, CA	Cold-rolled galvanized, tin mill	[223]50%
Gary, IN	Plate processing	[224]49%
Houston,TX	OCTG finishing	[225]50%
Dearborn Eagle, MI	Coated products	[226]50%

[218] *Iron Age*, October 1988, at 34. This is attributed to capacity increases (the EAF and hot-strip mill), downsizing of Ford's cars and trucks. Rouge no longer exclusively supplies Ford, but also supplies several transplanted Japanese automobile companies.

[219] Discussions with company officials, March, 1990.

[220] *USX Annual Report*, 1989

[221] Calculation is for combined sales before adjustments and eliminations for sales between segments as presented in the USX *Annual Report* for 1989.

[222] Japan's Kobe Steel purchased 50 percent of the bar operations in June of 1989.

[223] Korea's Pohang Steel owns the other 50 percent of the facility.

[224] Feralloy Midwest Corp. is the managing partner and majority owner of this conversion operation.

[225] Camp-Hill Corp. is a 50-percent partner and the facility operator in this tubular finishing operation.

[226] USX and Rouge Steel operate a 700,000-ton capacity electrogalvanizing line.

Efforts Related to Facilities

Changes in Corporate Structure

Formation of Joint Ventures

The most significant change in ownership for USS during 1989 was the sale of 50 percent of Lorain Works to Kobe Steel of Japan in the second quarter of the year. Under the terms of the agreement, USS will continue to market tubular products produced at the facility while USS and Kobe will jointly market bar products.

Since the Lorain Works previously accounted for approximately 14 percent of USS raw steel capacity, future production and operating levels for the company will decline; lower annual operating income in 1989 was, in fact, attributed by the company to the sale of this facility.[227]

Sale of a partial interest in the facility is expected to benefit USS in several ways. Purchase of the plant will reportedly provide a long-term cash infusion of more than $250 million.[228] Investment is to include purchases of new equipment and process controls by the partners, including possible installation of a continuous bloom caster. Domestic bar market penetration may also expand as Kobe apparently enjoys an excellent reputation among Japanese automobile manufacturers, many of whom have production or assembly facilities in the United States and are interested in increasing the domestic steel content of their products.

In addition to the sale of a portion of the Lorain works, USX and Kobe Steel also formed a 50-50 joint-venture partnership in early 1990 to produce approximately 600,000 tons of galvanized steel sheet annually. The new facility will be located in Leipsic, OH; semiprocessed sheets will be supplied from the Gary, Fairless and Fairfield mills for finishing. Construction of the facility, Aztec Coating, is currently underway.

Changes in Operations

Investment in New Equipment

In 1989, USX spent approximately $365 million in capital expenditures related to modernization. The company's annual report notes that facility investments, "continue to be directed toward modernization, cost reduction and improvements in productivity, energy efficiency, product quality and customer service, in addition to environmental and other legally mandated expenditures."[229]

South Works and Gary Works

These plants are considered one unit for accounting purposes and for some planning and investment; together they account for about 50 percent of all USS steel production. Improvements at Gary Works were the focus of much of USS' modernization efforts during 1989-90; investments in new equipment were based on the end goals of improving the quality and variety of products, as well as reducing costs by idling older equipment. Since 1986, approximately $240 million has been allocated for facility improvements.

During 1989-90, installation of insulating covers and computerized hydraulic gauge controls on the hot strip mill was completed. These improvements will reduce energy costs and improve the physical characteristics of sheet products. Installation of a circulating vacuum degasser was also completed, which will result in lower cost, higher quality clean steel, including some ultralow carbon steels for automotive sheet. In addition, a $20

[227] *USX Annual Report*
[228] *American Metal Market*, March 15, 1990
[229] *USX Annual Report*, 1988.

million project to install hydraulic gauge controls for closer tolerance in plate production will begin by the fall of 1990.[230]

There has recently been initiation of another important modernization project; the contract has been let for installation of a third continuous caster, due to be operational in 1991. With commission of the third caster, Gary Works' production will be 100-percent continuously cast, with a capacity of approximately 7 million tons per year. About two-thirds of the new caster's 1.6 million ton output will be converted to plate products for use in the automotive, structural, pipe and high-strength steel applications. Remaining output will be converted into coils for further sheet and tin mill product processing.[231]

During 1989, several upgrades designed to improve quality at the tin mill were also completed. These included improvement of the No. 2 continuous annealing line in order to increase through-put of materials and improve delivery times, and installation of a new coating weight gauge, looping towers and end-of-the-line accumulator to improve coating weight uniformity. These actions are designed to facilitate expansion into the beverage container market; currently, USS tinplate is reported to be the dominant domestic source for the food canning industry.[232]

During these modernization efforts Gary has served as the flagship of much of the company's process research. For example, the reline of Gary's No. 13 blast furnace included installation of a new type of refractory lining and cooling configurations in an effort to extend the life and reliability of blast furnaces between relines, and increase productivity.

Mon Valley

Mon Valley Works near Braddock, PA, consists of the Edgar Thompson Plant, which has three blast furnaces, a BOF and two rolling mills, and the Irvin plant, which has finishing operations and coating lines. Current modernization efforts at Mon Valley are focusing on the hot end, as agreed in the 1987 labor agreement between USX and the United Steelworkers of America (USAW). Under terms of that contract, management agreed to install a caster at the Edgar Thompson plant by 1992. Early in 1990, USS announced that groundbreaking for a conventional slab caster will take place before the end of the year.[233] Total estimated cost is $400-500 million, including related expenditures in 1989 for engineering studies.[234]

Other upgrades at the plants have included installation of a closed loop control system for the temper and cold-rolled mills and an energy-saving rebuild of the annealing facilities, which will now use 100 percent hydrogen. Estimated cost savings attributable to these improvements is $5 million annually.[235]

Fairfield Works

The final phase of a $400-500 million upgrade of the hot strip mill was completed in late 1988 with the commission of a second continuous caster. Subsequently, USS began upgrading a six-stand 52 inch cold reduction mill to accommodate processing of wider coils from the hot strip mill and to enhance product quality for automobile, appliance, and tubemaking markets. This upgrade centers on overhauling drives and upgrading entry and exit equipment. The project will increase the capacity of the mill and allow retirement of the plant's older four-stand mill. The current program should be completed by mid-1990 and will cost an estimated $15 million; total cost of renovating the cold mill is estimated by company officials to be $300 million.[236]

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[230] Discussions with company officials, March 1990.
[231] *33 Metal Producing*, January 1990.
[232] Discussions with company officials, March 1990.
[233] *American Metal Market*, Feb. 2, 1990.
[234] Discussions with company officials, March 1990.
[235] Discussions with company officials, March 1990.
[236] *Metal Bulletin Monthly*, May 1989 and discussions with company officials March 1990.

USS-Kobe (Lorain)

A $40 million modernization of the seamless tube mill was completed in 1989, including replacement of a tube reheat furnace, stretch reducing mill, and cooling bed. Other improvements included modifications to the mandrel mill and replacement of several older pieces of equipment with new saw and cut-to-length lines. These efforts are in response to industry demands for improved surface quality and dimensional tolerances for seamless tubular products.

Tubular production is expected to rise 6 percent as a result of these improvements. Future plans include ***.[237]

USS-Posco

A $400 million modernization program at the Pittsburg, CA facility was completed in March 1989, but full operation of the facility was delayed pending settlement of a legal dispute with certain unions.[238] Most issues were resolved in early 1990 and the company now anticipates reaching full annual output of 1.3 million tons of galvanized products and tinplate. Modernization of facilities included installation of an automated, computer controlled closed-loop pickle line and cold reduction mill. The installation of the closed-loop system allows recycling of the pickling liquor (such as hydrochloric acid) and simultaneously produces ferric oxide, which is sold to outside customers; previously pickling liquor was sold to a maker of ferric chloride [239]

Worthington Industries

Startup of a second cut-to-length line began in the second half of 1989. Designed to handle coils up to 90,00 pounds, the new line will provide additional specialized tonnage to meet the increased needs of the automotive and appliance industries. Site capacity is now 660,000 annual short tons.[240]

Feralloy Processing Company

Construction continues on a processing center designed to cut, level and shear strip mill plate up to 96 inches wide and 120 feet in length. The intention is to service the Chicago market. The facility will be the first of its kind in the United States to be owned by an integrated steel producer.[241]

Clairton Works

Clairton Works, Clairton, PA, is the largest domestic cokemaking operation, with 12 batteries accounting for approximately 15-20 percent of domestic coke production.[242] Because of increasingly strict state and federal guidelines regulating toxic discharges from coke production, modernization efforts have focused on installation of environmental controls, with approximately $62 million spent since the mid-1980s. Much of this amount targeted programs, such as installation of coolers for higher water quality, which were completed in 1989. While environmental expenditures are not routinely associated with productivity or cost-reduction benefits, industry spokesmen point out that avoidance of legal fines is indeed a cost savings.

In January 1990, a second phase of environmental upgrades, to be completed over 3 years, was announced by USX spokesmen. Total cost of the upgrades is estimated to be $89 million.

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[237] *Metal Bulletin Monthly*, May 1989 and discussions with company officials, March 1990.
[238] Following USS-Posco's use of nonunion labor in new facility construction, several construction unions filed a lawsuit charging that the company had failed to file an environmental impact statement and asking for an injunction against operation of the new equipment.
[239] *American Metal Market*, March, 1990 and USX press releases.
[240] *Metal Bulletin Monthly*, May 1989
[241] *Metal Bulletin Monthly*, May 1989
[242] Discussions with company officials, March 1990.

Despite sizeable fines for safety violations, Clairton Works has consistently passed environmental inspections and in 1989 sludge recycling efforts at the plant resulted in the "Governor's Waste Minimization Award" from the Pennsylvania Department of Environmental Resources.[243]

Input Costs

Actions Related to Raw Materials

In 1988, USS began to make and utilize a higher ratio of "fluxed" pellets as the blast furnace burden of choice. Such pellets increase BOF efficiency and decrease the amount of coke required. During 1989-90 USS continued to increase the use of such burden wherever possible. Lorain began using pellets on a trial basis and is expected to increase usage to 100 percent soon; currently fluxed pellets are the standard burden material at Mon Valley and Gary Works.

Other savings in input costs include the negotiation of long-term agreements for the purchase of coke with the intention of upgrading coke stability in anticipation of future coal injection. It is unclear as yet whether negotiated prices will, in fact, result in cost savings as coke prices are highly variable; in 1989, coke prices on the open market reportedly ranged from $75 to $135/net ton.[244]

The most important future savings in coking costs will come from institution of coal injection at the Gary works, scheduled for start-up by 1992. USS officials estimate savings of $5-15 per ton of steel, given a set-up cost of ***.[245]

USS has also continued to reduce energy costs as a percentage of total steel production costs through conservation methods such as electricity co-generation and renegotiation of supply contracts to allow purchase of natural gas at the well-head rather than buying from local distributors. Because of such efforts, energy costs declined from about 25 percent of steelmaking production costs a decade ago to approximately 19 percent of costs in 1989.[246]

Certain recycling efforts also provide cost savings. Nearly $2 million annually is being saved in landfill, coal and energy costs at USS' Clairton works by recycling coal tar sludge. The sludge is separated, treated and sprayed on incoming coking coal to increase bulk density. The reconfigured sludge improves coke oven performance by taking advantage of the liquid's high ratio of BTUs per gallon, with a resultant savings in energy costs.[247]

Another example of reduced raw materials' costs through recycling is the increased utilization of steel cans as scrap feed and aluminum cans for deoxidation of the steel mix. In conjunction with Marathon Oil Company, another USX subsidiary, "reverse vending" machines were installed at various service station locations throughout Indiana and Ohio. Collected steel and aluminum cans are then separated, detinned (if steel), and remelted as part of the steelmaking mix.

Actions Related to Labor

A 3-year labor agreement signed in 1987 eased manning requirements and allowed some contracting out of jobs. These concessions contributed to improved productivity in subsequent years[248], including 1989, which saw implementation of the final retirement provisions of the contract. Provisions of the 1987 agreement expire in February of 1991.

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[243] *Iron Age*, August 1989
[244] Discussions with company officials, March 1990.
[245] Discussions with company officials, March 1990.
[246] *USX Annual Report*, 1989
[247] *Iron Age*, August, 1989
[248] The company estimates that productivity has increased from 6 man hours/ton shipped in 1984 to 3.8 man hours/ton shipped in 1989.

To date, USS has denied requests by the USWA to renegotiate the contract in light of the more generous contracts recently signed by other major steel producers. Both parties anticipate that negotiations will begin in late-1990, however.

Research and Development Activities

USS expenditures for research and development were approximately *** percent of all capital expenditures for the questionnaire reporting period. The research and development division of USS is both process and product oriented. Research and development teams often provide long-term in-plant analysis and support with the goal of producing products more efficiently. In addition, facilities and staff are available to develop specific products to meet customer requirements. This approach reflects the company philosophy that "ideas come from involvement" and has resulted in a more accurate assessment of where modernization dollars may best be spent.[249]

Market Related Activities

Product/Market Development and Refinement

In the past 18 months several new products have been developed. Requirements by the American Petroleum Institute for an improved grade of carbon steel plate prompted development of a new product, called "O-Ten", by USS. Intended for use by oil and gas producers in harsh conditions of deep offshore drilling and production sites, the plate was developed at Gary Works during 1989. USS claims that this product is directly competitive with a similar product previously available only from Japanese mills.[250]

A new coating process for ***.[251] Coatings research is also underway for tin mill products' applications.

Actions to Improve Product Quality and Customer Service

In an effort to reduce rejection rates and increase the timeliness of delivery, USS divisions have instituted a number of programs. Company officials note, however, that conscious commitment to invest in new equipment is the single most important means to provide improved products for the customer.

In the raw materials area, vendors are audited periodically to insure quality inputs. For some products, customer-need surveys and improved electronic tracking of materials have been instituted. To monitor improvements, customer comments are solicited and independent testing has increased.[252] In addition, USS has entered several-joint-venture processing arrangements primarily to guarantee that customers in a geographic region are able to receive quality products in a timely manner. USS personnel work in the facilities with the operating company to insure that customer specifications are met.

Company officials report great improvement in both service and quality. For example, delivery times on tin mill products have increased from 60 percent on-time-deliveries in 1986 to a current rate of *** percent. The quality of coated sheet products has also improved significantly. Previously, products had failed all qualifying trials for use by Toyota at its domestic auto facilities. Since the modernization of hot strip mills at several plants, USS sheet products are reportedly now within qualifying range.

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[249] Discussions with company officials, March 1990.
[250] *American Metal Market*, February 1990.
[251] Discussions with company officials, March 1990.
[252] USS is a member of the Steel-Automotive Partnership which conducts independent testing of sheet product quality.

WEIRTON STEEL CORPORATION

Background

Weirton was the eighth-largest steel producer in the United States in 1989. Previously operating as the Weirton Steel Division of National Steel Corporation, Weirton became an independent, wholly employee-owned company in 1984. Prior to 1989, it was the nation's largest such company, with approximately 8,000 employees.

Weirton has one production facility, which is located in Weirton, West Virginia. It produces hot- and cold-rolled sheets, tin mill products (TMP), and hot-dipped and electrolytic galvanized sheets.

As the nation's largest TMP producer, Weirton ships about 35-40 percent of its finished products to the container market (primarily for food containers) and another 35-40 percent of its finished products to service centers. Smaller markets include the automotive, construction and certain high value-added niche markets.[253]

Weirton shipped nearly 2.5 million tons of steel in 1989, down from 2.7 million tons in 1988. Its recorded profits of $16.0 million on sales of $1.3 billion represented a considerable improvement from 1988, when the company recorded a net loss of $2.2 million on $1.4 billion in sales. The decreases in shipments and revenues in 1989 were attributed to the disruptive effect of bringing new equipment on line and a softening in markets in the last part of 1989.[254]

According to company officials, Weirton's overall competitive strategy is to maintain its leadership position in the TMP area, as well as the light gauge, deep drawn, sheet product area. To achieve this goal, the company implemented a five-year capital modernization program in 1988, which is designed to improve product quality, increase productivity and lower costs.

Changes in Corporate Structure

In order to supplement available funds for the capital modernization program, Weirton employee-owners sold a portion of their equity position in the company in 1989. The employees had become 100-percent owners when they formed an employee stock ownership plan (ESOP) in 1984 in order to acquire the facilities comprising the Weirton Steel Division from National Intergroup, which had announced its intention to close the hot end of the plant 2 years earlier.

Although the ESOP allowed the company to continue operation, it limited the financial resources available to Weirton management, as the company was obligated to repurchase the stock of any current or retired employee who chose to sell it after 5 years, beginning July 1, 1989.[255] This posed a significant liability for Weirton, since it would have diverted funds away from the scheduled modernization program.

To avoid this, Weirton employees overwhelmingly approved a financial restructuring plan in March 1989, which authorized current employees to sell 35 percent of their holdings, and retired employees to sell all of theirs. The overall cap on public ownership was placed at 23 percent. In June 1989, Weirton received approval from the Securities and Exchange Commission to make its initial offering on the New York Stock Exchange.[256]

Another element of the restructuring plan designed to increase the availability of funds was the reduction of employee profit sharing from 50 percent to 35 percent through 1992. By approving this provision, Weirton employees accepted a need to forego current profit dividends in order to enhance the competitiveness of the company through investment in new equipment.

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[253] Interview with Weirton officials, Apr. 11, 1990. Also, Weirton Steel Corp., *Annual Report 1989*, p. 4.
[254] Weirton Steel Corp., *Annual Report 1989*, p. 3.
[255] Weirton Steel Corp., *Annual Report 1988*, p. 17.
[256] *American Metal Market*, June 15 1989, p. 2, 16.

In order to maintain employee control over the company for at least 15 years, the restructuring plan included a provision in which preferred stock, which was accorded greater voting power than common stock, would remain in control of employees through a second ESOP.[257]

Investment in New Equipment

Weirton initiated a 5-year, $500 million capital investment program in 1988. The program underwent several revisions, and, as of April 1990, the total planned investment surpassed $750 million. This represents a considerable increase in capital expenditures for Weirton, which spent only about a third of that amount ($260 million) in the previous five-year period (1984-88). Under the current program, Weirton spent $82 million in 1988 and $131 million in 1989. It expects 1990's expenditures to reach $181.5 million.[258]

Company officials consider the 5-year program essential in order to improve the plant's competitive position, which reportedly was relatively weak when the ESOP assumed ownership. In the first years under the ESOP, Weirton officials focused on building a knowledgeable sales and marketing work force (areas previously handled by workers at National's headquarters). The new capital expenditures program represents a shift towards meeting the company's capital equipment needs.[259]

To finance the program, Weirton will rely primarily on internally generated cash from net operating earnings. Additional funds will be obtained through the issuance of $300 million in senior notes, the refinancing of $56.3 million in pollution control bonds, and the previously mentioned sale of a portion of employees' equity holdings.[260]

There are two major projects specified in the capital plan: a revamp of the continuous slab caster and the renovation of the company's hot-strip-mill. In addition, the plan calls for the modernizing of the blast furnaces, installation of new technology at the finishing mills, and considerable environmental control work. In each case, at least part of the work or planning was done in 1989.

Hot End Modernization

Blast Furnace

Weirton considers its blast furnaces to be an area requiring considerable attention and has set aside $100 million to make improvements. The company's objective is to maintain its current crude steel output of 7,200 tons per day while cutting the number of furnaces from four to three, and operating two at any given time instead of three. Because British Steel successfully overcame a similar situation, Weirton is seeking its assistance with the upgrade. Most of the $8.7 million spent on blast furnace and sinter plant operations in 1989 was directed to the reline of the company's No. 3 blast furnace.[261]

Continuous Caster

The $75 million project to upgrade Weirton's 1968-vintage caster will allow Weirton to lower operating costs, increase yields, and meet customer demand for higher quality steel products. The current caster's maximum width of 40 inches limits the range of products that the rolling mills can produce, and the continuous cast ratio for 1989 was therefore limited to 62 percent. The upgrade of the caster will increase the maximum width to 49 inches, corresponding to the width of the hot strip mill, and thus enable the company to reach 100-percent continuous casting.[262]

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[257] Weirton Steel Corp. *News*, Jan. 29, 1989.
[258] Interview with Weirton officials, Apr. 11, 1990.
[259] *Iron Age*, April, 1990, pp. 31-32. Also, interview with Weirton officials, Apr. 11, 1990.
[260] Interview with Weirton officials, Apr. 11, 1990. Also, Weirton Steel Corporation, *Annual Report 1989*, p.3.
[261] Interview with Weirton officials, Apr. 11, 1990, and discussion with Weirton official, May 4, 1990.
[262] Interview with Weirton officials, Apr. 11, 1990. Also, Weirton Steel Corporation, *Annual Report 1989*, pp. 12-13.

In addition to having an increased width, the upgraded caster will have several features which will enhance the quality and consistency of cast slabs.[263] Because of these improvements, Weirton anticipates that improved slab quality will cut down on the need to perform surface checks on the ccoled slabs. Weirton has already reduced the ratio of slabs that need to be scarfed to slightly over one-half; after the modernization project, it expects the percentage to drop to 10 percent or less.

These projects, combined with the caster upgrade, are designed to allow Weirton to meet its needs for clean steel (i.e. steel that meets stringent requirements of internal and microcleanliness and of mechanical properties). Currently, Weirton is forced to buy slabs from Germany and France in order to produce sufficient quantities of quality sheet for deep draw applications.[264]

The new caster components, which are being engineered by SMS Concast and constructed by Samsung in Korea, are scheduled to be installed in October 1990. Weirton hopes to reach 100 percent continuous casting as quickly as possible after that, perhaps by early 1991.

Other

Other hot-end revamps include the replacement of the company's No. 7 basic oxygen process (BOP) steelmaking vessel, an upgrade of the vacuum degasser, and, as part of its clean steel program, external desulfurization of molten iron and BOP bottom stirring.[265]

Hot Strip Mill Revamp

Weirton is devoting $275 million, or over one-third of its total budget for the modernization program, towards a two-stage rebuild of its hot strip mill (HSM). It expects that when completed, the new HSM will be world class and will consistently be able to produce steel meeting gauge tolerances one-half the current industry standard.[266] The company considers the revamp of the HSM, whose last major upgrade was in 1955, to be the most essential part of its capital modernization program, and also the most challenging.[267]

The revamp is expected by company officials to open new markets. According to these officials, Weirton can only compete in 28 percent of the sheet market at present. At the end of the HSM revamp, it expects to be able to compete in 72 percent of the market.[268] Weirton officials also expect the revamp to improve productivity (from 400 tons per hour to 475 tons per hour) and increase capacity by over 20 percent (to 3.5 million tons per year).[269]

The first stage of the renovation, completed in November 1989 and costing $72 million, focused on upgrading the six finishing stands, which now have computerized gauge, shape and crown controls to improve quality and consistency. A new laminar strip cooling system controls temperature after the final pass, assuring more uniform metallurgical properties, and new insulated heat retention covers reduce heat loss and keep temperature more uniform. In addition, acceleration controls were added in order to promote uniform metallurgical properties and a new crop shear was automated

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[263] For example, the tundish will be reconfigured (to enhance sequence casting); the metallurgical length of the machine will be increased; multi point strand bending will be added as will computer controlled soft cooling; the mold oscillation frequency will be higher; and reusable units will be installed (to facilitate maintenance). The upgraded caster will also have improved safety features, including an auxiliary water supply, an emergency electrical power supply and break out detectors. (Interview with Weirton officials, Apr. 11, 1990. See also *Iron Age*, Dec., 1989, pp. 21-22).

[264] Interview with Weirton officials, Apr. 11, 1990.

[265] *Iron and Steel Engineer*, Feb. 1990, p. D 17.

[266] Weirton Steel Corp., *Annual Report 1989*, p. 9.

[267] *Iron Age*, Apr. 1990, pp. 29 37.

[268] Interview with Weirton officials, Apr. 11, 1990.

[269] *Iron Age*, Apr. 1990, p. 34.

(increasing operating efficiency).[270] The HSM was shut down for about 2 weeks in October 1989 in order to install a new computerized pulpit from which mill operations are controlled.[271]

The $203-million second phase of the HSM renovation began in late 1989 and is not expected to be completed until the first quarter of 1992.[272] As part of the project, Weirton will install two walking beam reheating furnaces, capable of handling larger slabs, thereby doubling maximum coil length. This will increase productivity and yield by reducing the number of weld cycles and minimizing crop loss. The new furnace, to be installed in the last quarter of 1990, should improve coil surface quality and gauge control.[273] Weirton also expects by the end of 1990 to reconstruct its reversing roughing mill to add heavy edging capability.[274]

Weirton is also planning to install a slab sizing press in 1992 that can reduce cast slab width before hot-rolling by up to 350 mm (14 inches). This will substantially reduce the number of slab sizes that need to be cast, increasing productivity in the casting operations. It will also provide flexibility in rolling inventoried slabs to order. The sizing press, which is being built in Japan, will be the second in the world and the first in the United States.[275]

In addition, Weirton plans to install a new crop shear, two new downcoilers, a seventh finishing stand, and a second new reheat furnace as part of the 5-year plan.[276]

Finishing Mill Improvements

Because the condition of the tandem cold mills is relatively good (compared to the hot-strip mill), significantly less work is required for modernization. Projects are, however, being undertaken in order to meet customer demands for high-quality finished products. In October 1989, for example, the company announced an upgrade of its finishing and coating lines amounting to $60 million. Although the schedule of the work has not yet been announced, the work will reportedly include additional annealing capacity, an upgrade to the tandem mill and strip steel department, upgrades to tin mill annealing, cleaning and plating lines, and improvements in the handling controls and galvanizing lines at the sheet mill.[277] In 1989, Weirton spent over $2 million to upgrade existing plating lines.[278]

Environmental Control Work

In March 1989, Weirton commissioned a new $23.8 million tin mill wastewater treatment plant as part of a hazardous waste management program. It also spent $2.7 million to close down two surface empilements in accordance with the Resource Conservation and Recovery Act. Other environmentally related expenditures in 1989 include $1.8 million for a wet scrubber for the blooming mill and $300,000 for a sinter plant cooler scrubber system.[279]

In addition, Weirton is constructing a wastewater treatment facility for its steelmaking and rolling operations, to be completed by September 1990. Western Virginia environmental regulations obliged Weirton to take this action in order to neutralize accidental acid/alkali spills, and to decrease iron deposits in the Ohio River. The cost of the facility, which is expected to be completed be the end of 1990, is about $16.1 million.

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[270] Weirton Steel Corp., *Annual Report 1989*, p. 8.
[271] *American Metal Market*, Oct. 11, 1989, p. 20.
[272] Weirton Steel Corp., *Annual Report 1989*, p. 8.
[273] Weirton Steel Corp., *Annual Report 1989*, p. 8.
[274] Discussion with Weirton official, May 4, 1990.
[275] *Engineer*, May 4, 1989, p. 39.
[276] Interview with Weirton officials, Apr. 11, 1990.
[277] *American Metal Market*, Oct. 11, 1989, p. 20.
[278] Information provided by Weirton official, May 4, 1990.
[279] Information provided by Weirton official, May 4, 1990.

As the wastewater passes through, debris, settleable solids, oil and grease will all be removed.[280] Weirton officials estimate that between 1984-89, approximately 21 percent of their capital investment was devoted to pollution control.[281]

Efforts to Control Raw Materials Costs

At a time when many coke plant operators are concerned about shutdowns due to increasingly stringent environmental regulations, Weirton is working with an outside contractor to rebuild its coke facilities, which have been shut down since 1982. It has considered such a rebuild before, but the financing has reportedly always been an obstacle. The project, estimated to cost about $250 million, would make Weirton self-sufficient in coke; it does not expect to produce an excess of coke for sale on the open market.[282] Currently, Weirton reportedly purchases metallurgical coke from outside suppliers, including Bethlehem, Shenango, and Mitsubishi.[283]

With respect to the permit needed for operating the coke plant (which can be difficult to obtain), Weirton officials noted that the permits issued for the ovens before shutdown would still be valid. They are also confident that the rebuild of the facilities would include sufficient environmental controls to preclude problems of compliance with environmental laws.

In addition, Weirton plans to spend $12 million to outfit its No. 1 blast furnace for coal injection. It expects to employ coal injection technology by 1991.[284]

Actions Related to Labor

In October 1989, the Independent Steelworkers Union (ISU), which represents about 6,000 workers at Weirton, reached a 4-year labor agreement with Weirton management. Weirton's previous labor contract expired on September 25, 1989, but was extended during the course of the negotiations. The new contract, which does not include any cost-of-living-adjustment provision, calls for an hourly increase of $2.09 over the life of the agreement. A portion of that increase, $0.85, was made retroactive to the end of the previous contract. Three subsequent increases, of $0.19, $0.70 and $0.35 per hour, will take place in 1990 and 1991.[285]

In addition, Weirton agreed to a one time special bonus to employees paid in the first 3 months of 1989, totaling $5.1 million. The new contract also partially restores the vacation and holiday reductions approved in the 1983 contract.

Although the new hourly wage rate at Weirton is below the average rate for many other integrated steel producers, the relatively large profit-sharing provisions of the ESOP narrow the differences. Weirton distributed $21.9 million in 1989 profit-sharing payouts, representing 35 percent of adjusted net income for 1989. The previous year's payout was the highest ever, $75 million, reflecting a 50-percent share. Another explanation for the apparent wage gap is Weirton's labor productivity (measured in manhours per ton) which appears to be below the average for integrated mills.[286] • • •.[287]

In addition to covering wage increase issues, the new contract stipulates that layoffs be used only as a last resort in work force reduction. • • •.[288]

Other important labor-related actions in 1989 include Weirton's efforts to improve communication and increase worker participation. Weirton publishes several regular bulletins and newsletters, and shows a weekly Weirton news video on 175 monitors

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[280] "Weirton Building Treatment Plant," *33 Metal Producing*, August 1989, p. 18. See also *Iron Age*, August 1989, p. 60.
[281] Interview with Weirton officials, Apr. 11, 1990.
[282] Interview with Weirton officials, Apr. 11, 1990. Also, *American Metal Market*, May 24, 1990, p. 2.
[283] *33 Metal Producing*, Jan. 1989, p. 39.
[284] Interview with Weirton officials, Apr. 11, 1990.
[285] *American Metal Market*, Oct. 30, 1989, p. 2.
[286] *American Metal Market*, Feb. 6, 1990, p. 2.
[287] Interview with Weirton officials, April 11, 1990.
[288] Interview with Weirton officials, Apr. 11, 1990.

throughout the company. In addition, Weirton has supported an Employee Participation Groups (EPGs) program. These groups, limited to about 15 salaried and nonsalaried employees, meet voluntarily to discuss work-related issues and are encouraged to point out problems and suggest solutions to upper management. Participation in the EPG training program is voluntary for workers, but mandatory for managers. Ten full-time facilitators coordinate the EPG program, which has hosted several visitors from the U.S. steel industry and other domestic and foreign industries who have come to learn about Weirton's innovative worker participation program.[289]

Weirton officials report that, despite this effort, employees often remain frustrated that opportunities for participation are not greater. They suggested that because employees are also owners, their expectations are high. When suggestions made by EPGs are not adopted by management, for example, the group sometimes becomes disappointed and disbands. Facilitators are modifying the program in an attempt to improve the groups' effectiveness.

Research and Development Activities

Weirton Technology Center (WEIRTEC), Weirton's research and development facility, focuses on developing and refining applications for its products. ***.

In the area of tin mill products, WEIRTEC has a commercial-scale experimental can-making facility where researchers work closely with can-making clients to evaluate materials, equipment and end products. Its size allows it to simulate a client's production facility and thereby study ways to improve its product quality and make its production process more efficient.[290]

In 1989, research at WEIRTEC focused on two areas. First, it worked on developing technology to lower requirements for tin coating for cans from .25 pounds to .05 pounds per base box. Second, it worked on developing a new system for the production of two-piece cans. Known as DTR®, the system lowers material and production costs while improving efficiency and quality.[291]

In the area of sheet products, WEIRTEC has undertaken long term projects to study the corrosion resistance, formability and coating integrity of galvanized steels.[292]

Product/Market Development and Refinement

Weirton participates in an effort among a group of eight steel producers to promote the use of tin mill products in the food and beverage can market. The group is organized by the American Iron and Steel Institute's Tin Mill Product Producers Committee. The company, along with USS, has technical centers which have been active in trying to persuade customers on the merits of steel.[293] This campaign is critical to Weirton, given its reliance on tin mill products. Alternative materials, such as glass, paperboard, composites and aluminum, are making inroads into steel's position in the container markets, largely due to the demand for non-metallic microwaveable food packages. The Tin Mill Product Producers Committee is trying to maintain steel's position, and regain some of its lost position in the beer and beverage market.

In 1989, Weirton initiated marketing activities to enter into a new market: specular lighting fixtures. Weirton is currently the only steel company qualified to meet the surface quality demands for this application, which uses black plate steel as a base substrate. The company expects this to be a rapidly growing market in the next few years.[294]

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[289] Interview with Weirton officials, April 11, 1990.
[290] Weirton Steel Corporation, *Weirtec Center*, (brochure)
[291] Weirton Steel Corp., *Weirtec Center*
[292] Weirton Steel Corp., *Annual Report 1989*, p. 10.
[293] Wallace D. Huskonen, "Tinplate Turnaround," *33 Metal Producing*, December 1989, pp. 15 18.
[294] Weirton Steel Corp., *Annual Report 1989*, p. 14.

Actions to Improve Customer Service

By the end of 1990, Weirton expects to have spent $7 million on a company-wide integrated manufacturing information system (IMIS) to provide real-time tracking of customer orders at all phases of operations. Previously, this function was performed manually. IMIS is designed to improve customer service by providing timely information on the status of a customer's order, by avoiding delays and errors in processing orders, and by speeding up delivery times. The multiphase project is expected to take several years to complete.[295]

WHEELING-PITTSBURGH STEEL CORPORATION

Introduction

Wheeling-Pittsburgh Steel Corporation, whose corporate headquarters are located in Wheeling, WV, is the ninth-largest integrated steel company in the United States (based on domestic raw steel production in 1989). During 1989, raw steel production totaled 2.5 million tons,[296] which represented about 3 percent of domestic raw steel production. Total employment of Wheeling-Pittsburgh and its subsidiaries averaged about 6,300 workers during 1989. Wheeling-Pittsburgh has operated under chapter 11 bankruptcy since 1985.

Following is a list of Wheeling-Pittsburgh's principal steel producing facilities, their locations, the products manufactured at these facilities, and the percent of ownership by Wheeling-Pittsburgh:

Facility	*Products*	*Ownership*
Steubenville plant Steubenville, OH	Ingots, slabs, hot-& cold-rolled sheet	100%
Allenport plant Allenport, PA.	Cold-rolled sheet	100%
Yorkville plant Yorkville, OH	Blackplate, electrolytic tinplate, light gauge cold-rolled sheets & coil	100%
Martins Ferry plant Martins Ferry, OH	Continuous galvanized sheets & coils	100%
Beech Bottom plant Beech Bottom, WV	Decking, painted coils, expanded metal, galvanized spiral culvert & other fabricated products	100%
Labelle Works Wheeling, WV	Cut nails	100%
Canfield Canfield, OH	Electrolytic galvanized sheet & strip	100%

As part of Wheeling-Pittsburgh's continuing efforts to reorganize under chapter 11, the corporation sold its stock investment in Nisshin Steel Company (Japan) for a profit of $45 million in August 1988.[297] The corporation purchased the stock in 1984 as part of a cooperation agreement with Nisshin Steel. This transaction did not affect the corporation's investment in Wheeling-Nisshin, Inc., which began a coating operation in Follansbee, WV, in April 1988.

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[295] *Industry Week*, Aug. 7, 1989, p. 56.
[296] American Metal Market, Feb. 9, 1990.
[297] News Release from Wheeling-Pittsburgh, January 19, 1990.

The company reported net income of $179.3 million on shipments of 2.3 million tons during 1989, which represented a 31 percent decrease in net income from 1988, when Wheeling-Pittsburgh recorded net income of $259 million of shipments of 2.2 million tons.[298] Net income during 1988 included a net gain of $44.9 million from the sale of securities and an investment tax credit refund of $14.0 million. Accounting for these factors, net income in 1989 would have declined by a lesser 10 percent from the 1988 level.[299]

With respect to net sales during 1989, however, Wheeling-Pittsburgh recorded an increase of 4 percent ($43.6 million), to $1.1 billion. The increase in sales during 1989 reflects a 2.4 percent increase in steel shipments, coupled with a 1.8 percent increase in the prices of various steel products during the period.[300]

Efforts Related to Facilities

Changes in Corporate Structure

Acquisition of Existing Facilities

In July 1989, Wheeling-Pittsburgh and Cyclops Industries, Inc., announced that Wheeling Corrugated Company (a division of Wheeling-Pittsburgh) purchased the assets of Cyclops' Bowman Metal Deck Division located in Fort Payne, AL. The acquisition of the facility, which produces floor and roof decking for nonresidential building, is intended to broaden Wheeling Corrugating's service to the construction industry.

Changes in Operations

Investment in New Equipment

Wheeling-Pittsburgh has made significant investments to upgrade or purchase equipment in order to enhance product quality, increase productivity, reduce production costs, and comply with environmental policy. In 1989, capital spending totalled over $100 million.[301]

Steubenville Plant

At the Steubenville facility, capital spending to upgrade the BOF steelmaking facility and the 80-inch hot-strip mill included the installation of a computer that is designed to control reheating furnaces, and a metallurgical testing laboratory.[302] Wheeling-Pittsburgh also installed a ladle-turret lifter, a ladle transfer car, a breakout avoidance system, and a chemical reheat station at this facility.[303]

Yorkville Plant

During the first quarter of 1989, Wheeling-Pittsburgh installed tension leveling equipment to improve the flatness and quality of its tin mill products. The new equipment is comprised of two tension leveling systems from Wean Industries, Inc.; cost of the equipment exceeded $3 million. The tension levelers have been added to the No. 1 and No. 2 electrolytic plating lines at the company's Yorkville, Ohio plant.[304] During the tension leveling process, steel sheet is put under constant flexion and tension in order to correct defects such as long edges, buckles, and ripples. The final result is a flatter product with a more uniform surface.

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[298] News Release from Wheeling-Pittsburgh, Jan. 19, 1990.
[299] Ibid.
[300] Ibid.
[301] *Iron and Steel Engineer*, February 1990.
[302] Ibid.
[303] Ibid.
[304] News Release From Wheeling-Pittsburgh, Mar. 15, 1989.

Allenport Plant

Wheeling-Pittsburgh has also decided to proceed with the installation of automatic gauge control (AGC) and shape control equipment (including roll-shifting and bending) at the company's 60-inch tandem cold mill located in Allenport, PA.[305] This modernization will allow the company to broaden its product line for cold-rolling applications and better meet demand in the marketplace. The installation of the AGC system, which will replace manual gauge controls at the mill, is intended to help Wheeling-Pittsburgh meet the more stringent tolerance and flatness standards of its customers. In addition, the 66-inch cold-reduction mill is to be modernized with automatic gauge and shape controls for roll-shifting and roll-bending.[306]

Future Investments

Wheeling-Pittsburgh is planning capital investments of more than $800 million during 1990-99. The following tabulation shows the amount of capital spending that is to be used during this period in certain operational areas at various affiliated operations:

Value (in millions of dollars)

Area	Continuance of operations	Productivity & quality improve ment	Support facilities	Infrastru- ture	Environ- mental	Total
Steubenville	...	...	...	...	...	...
Allenport	...	...	...	...	...	...
Yorkville	...	...	...	...	...	...
Martins Ferry	...	...	...	...	...	...
Canfield	...	...	...	...	...	...
Wheeling Corrugating	...	...	...	...	...	...
W-P Coal Company	...	...	...	...	...	...
Info. svc & Duvall Center	...	...	...	...	...	...
Other[1] Adm ofc/Gtwy Ctr/ other	...	...	...	...	...	...
Total	...	...	...	...	...	970.4

[1] Industry administration offices.

Source: Provided by Wheeling-Pittsburgh Steel Corporation.

Input Costs

Actions Related to Raw Materials

As a result of filing under chapter 11, Wheeling-Pittsburgh was able to renegotiate its sources of iron ore pellets.[307] The corporation had previously secured a substantial portion of its iron ore pellets through a minority interest in several mines, which were located in Michigan, Minnesota, and Canada. After filing for bankruptcy, however, the corporation was able to purchase its iron ore requirements through short- and medium-term purchase agreements at prevailing world prices, which have been below those paid for much of the iron ore from North American mines in recent years.

On June 25, 1989, Wheeling-Pittsburgh reduced coke production at its Follansbee, WV, cokemaking facility by 15 percent.[308] The cutback in production at the facility resulted from strikes undertaken by the United Mineworkers of America (UMW) throughout West Virginia, Pennsylvania, Virginia, Kentucky, and Tennessee. Wheeling-Pittsburgh was able to meet its coke requirements and maintain blast furnace operations only by drawing down its coke inventories and sourcing additional coke from more costly outside sources.

[305] *Iron Age*, "Wheeling-Pittsburgh to Install AGC System at Allenport Cold Mill" December 1989, page 12.
[306] *Iron and Steel Engineer*, Feb. 1990.
[307] Wheeling-Pittsburgh Corp.'s Annual Report and Form 10K, 1988.
[308] News Release from Wheeling-Pittsburgh, June 27, 1989.

Actions Related to Labor

Wheeling-Pittsburgh has agreed to support a reorganization plan suggested by its creditors, marking a breakthrough in the steelmaker's 5-year bankruptcy proceedings. One current stumbling block to the plan's success, however, is the lack of an accord with the United Steel Workers of America (USWA).[309] The USWA is seeking a contract similar to the one approved by LTV Steel Co., whose parent company, LTV Corp., is also operating under Chapter 11 protection.[310] Wheeling-Pittsburgh officials and creditors, however, believe the LTV agreement is too costly.

USWA officials have asserted that negotiations are unlikely to resume until the union can determine the majority ownership of the steelmaker once it emerges from Chapter 11 protection.[311] The USW insists that Wheeling-Pittsburgh agree to the pattern for wages and benefits that were negotiated in 1989 throughout most of the steel industry. Under bankruptcy laws, Wheeling-Pittsburgh must have a successor pact to emerge from Chapter 11, or the current labor contract expires within 10 days after its emergence. According to USWA officials, the corporation can easily afford the industry pattern on wages and benefits, or at least match the pact agreed to by LTV Steel Co., since Wheeling's 1989 operating profit of $61 per ton was $21 higher than LTV's and $26 higher than the average of four other major integrated producers.[312]

Wheeling-Pittsburgh has offered what it considers to be a generous wage and benefit package totaling $40 million a year. According to Wheeling officials, the USWA proposal would boost wages by more than $11 an hour, or by $50 per ton by 1994.[313]

Market Related Activities

Actions to Improve Customer Service

Wheeling-Pittsburgh has made a concerted effort to improve customer service through the implementation of an electronic information tracking system. This system allows the corporation to track orders expeditiously in every phase of steel fabrication. In addition, the system has had the effect of getting orders to the customer on a more timely basis.

[309] *The Wall Street Journal*, Apr. 17, 1990.
[310] Ibid.
[311] American Metal Market, Mar. 14, 1990.
[312] Ibid.
[313] Ibid.

APPENDIX H
HISTORICAL FINANCIAL TABLES, 1984–1990

Table H—1

Steel: Financial experience of U.S. steel producers, July 1, 1984—June 30, 1989 and U.S. producers and converters, by specified periods[1] [2]

(1,000,000 dollars)

Item	July 1, 1984—June 30, 1985	July 1, 1985—June 30, 1986	July 1, 1986—June 30, 1987	July 1, 1987—June 30, 1988	July 1, 1988—June 30, 1989	Jan. 1, 1989—Dec. 31, 1989	Jan. 1, 1990—Mar. 31, 1990
Net sales:							
Excluding intracompany and intercompany transfers	30,023	29,052	28,354	33,391	39,921	48,408	11,648
Intracompany and intercompany transfers	3,026	2,964	2,361	29,510	2,448	3,018	607
Total net sales	33,049	32,016	30,715	38,612	42,369	51,426	12,254
Cost of goods sold (including intracompany and intercompany transfers):							
Raw materials	10,670	10,290	7,772	5,772	10,566	14,876	3,560
Direct labor	5,897	4,736	3,287	4,630	5,096	6,067	1,515
Other factory costs, including depreciation and amortization	13,813	13,553	8,058	8,340	10,091	11,937	3,045
Total cost of goods sold	32,147	31,138	28,668	33,922	36,779	45,366	10,967
Gross profit or (loss)	902	878	2,027	4,689	5,590	6,060	1,287
General, selling, and administrative expenses	1,431	1,434	1,356	1,467	1,759	2,414	627
Net operating profit or (loss)	(530)	(556)	671	3,223	3,830	3,646	660
Other income or (expense):							
Net interest income or expense	(547)	(761)	(366)	(588)	(441)	(536)	(149)
All other income or (expense)[3]	81	98	(3,332)	9	(1,518)	(118)	(40)
Total other income or (expense)[4]	(466)	(663)	(3,698)	(579)	(1,959)	(654)	(189)
Net profit or (loss) before taxes	(996)	(1,219)	(3,028)	2,644	1,872	2,992	471
Depreciation and amortization	2,663	1,435	1,453	1,823	1,519	1,799	465

[1] Certain respondents included financial information on related products.

[2] Data for the 12-month periods running from July 1 to June 30 is drawn from questionnaires submitted in response to USITC investigation 332-209, which collected information only from firms which melted and poured raw steel. Data for calendar year 1989 and Jan.-Mar. 1990 also includes firms which convert semifinished steel products to finished products which are included by the Voluntary Restraint Agreements.

[3] Certain respondents reported extraordinary and nonrecurring expenses.

[4] Including nonitemized income and expenses.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table H-2

Steel: Financial experience of U.S. integrated steel producers, by specified periods

(1,000,000 dollars)

Item	July 1, 1984-June 30, 1985	July 1, 1985-June 30, 1986	July 1, 1986-June 30, 1987	July 1, 1987-June 30, 1988	July 1, 1988-June 30, 1989	Jan. 1, 1989-Dec. 31, 1989	Jan. 1, 1990-Mar. 31, 1990
Net sales:							
Excluding intracompany and intercompany transfers	22,816	21,689	20,897	27,224	29,436	27,841	6,402
Intracompany and intercompany transfers	2,461	2,556	1,791	1,681	1,692	1,817	303
Total net sales[1 2 3]	25,278	24,245	22,688	28,906	31,128	29,658	6,705
Cost of goods sold (including intracompany and intercompany transfers):							
Raw materials	8,579	8,240	5,962	2,982	6,656	6,151	1,436
Direct labor	4,970	3,826	2,432	3,516	4,146	4,088	969
Other factory costs, including depreciation and amortization	11,094	10,993	5,488	5,206	6,930	6,890	1,699
Total cost of goods sold[4]	25,017	24,079	21,624	25,595	27,388	26,562	6,181
Gross profit or (loss)	260	166	1,064	3,310	3,740	3,096	525
General, selling, and administrative expenses	913	948	857	998	1,203	1,154	292
Net operating profit or (loss)	(653)	(782)	207	2,313	2,536	1,942	232
Other income or (expense):							
Net interest income or expense	(394)	(584)	(218)	(437)	(230)	(153)	(46)
All other income or (expense)	172	99	(3,294)	75	(1,443)	(71)	(21)
Total other income or (expense)[5]	(222)	(485)	(3,512)	(362)	(1,673)	(224)	(68)
Net profit or (loss) before taxes	(875)	(1,267)	(3,305)	1,950	863	1,718	165
Depreciation and amortization	1,077	1,125	1,124	1,510	1,210	1,147	287

[1] Due to rounding totals may not add.

[2] Includes nonitemized sales.

[3] Certain respondents included financial information on related products.

[4] Including nonitemized costs.

[5] Including nonitemized expenses.

Source: Compiled from data submitted in reponse to questionnaires of the U.S. International Trade Commission.

Table H-3

Steel: Key financial ratios of U.S. integrated steel producers, by specified periods July 1, 1984- March 31, 1990

(Percent of total net sales)

Item	July 1, 1984-June 30, 1985	July 1, 1985-June 30, 1986	July 1, 1986-June 30, 1987	July 1, 1987-June 30, 1988	July 1, 1988-June 30, 1989	Jan. 1, 1989-Dec. 31, 1989	Jan. 1, 1990-Mar. 31, 1990
Net sales:							
Excluding intracompany and intercompany transfers	90.3	89.5	92.1	94.2	94.6	93.9	95.5
Intracompany and intercompany transfers	9.7	10.5	7.9	5.8	5.4	6.1	4.5
Total net sales	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cost of goods sold (including intracompany and intercompany transfers):							
Raw materials	34.5	35.5	40.9	36.0	33.0	32.2	32.2
Direct labor	19.9	16.5	16.7	21.2	20.6	21.4	21.8
Other factory costs, including depreciation and amortization	44.6	47.3	37.7	31.3	34.4	36.0	38.2
Total cost of goods sold[1]	99.0	99.3	95.3	88.5	88.0	89.6	92.2
Gross profit or (loss)	1.0	0.7	4.7	11.5	12.0	10.4	7.8
General, selling, and administrative expenses	3.6	3.9	3.8	3.5	3.9	3.9	4.4
Net operating profit or (loss)	(2.6)	(3.2)	0.9	8.0	8.1	6.5	3.5
Other income or (expense):							
Net interest income or expense	(1.6)	(2.4)	(1.0)	(1.5)	(0.7)	(0.5)	(0.7)
All other income or (expense)	0.7	0.4	(14.5)	0.3	(4.6)	(0.2)	(0.3)
Total other income or (expense),	(0.9)	(2.0)	(15.5)	(1.3)	(5.4)	(0.7)	(1.0)
Net profit or (loss) before taxes	(3.5)	(5.2)	(14.6)	6.7	2.8	5.8	2.5
Depreciation and amortization	4.3	4.6	5.0	5.2	3.9	3.9	4.3

[1] Estimated by the staff of the U.S. International Trade Commission based on partial company responses.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table H-4

Steel: Financial experience of U.S. minimills, by specified periods[1]

(1,000,000 dollars

Item	July 1, 1984-June 30, 1985	July 1, 1985-June 30, 1986	July 1, 1986-June 30, 1987	July 1, 1987-June 30, 1988	July 1, 1988 June 30, 1989	Jan. 1, 1989-Dec. 31, 1989	Jan. 1, 1990-Mar. 31, 1990
Net sales:							
Excluding intracompany and intercompany transfers	4,845	5,324	5,189	5,840	6,231	9,599	2,657
Intracompany and intercompany transfers	375	362	412	361	391	644	178
Total net sales	5,219	5,686	5,601	6,200	6,622	10,264	2,835
Cost of goods sold (including intracompany and intercompany transfers):							
Raw materials	1,504	1,637	1,382	1,929	2,601	3,321	902
Direct labor	652	703	616	785	621	1,006	302
Other factory costs, including depreciation and amortization	1,652	1,898	1,752	2,182	2,153	2,902	793
Total cost of goods sold[2]	4,783	5,126	4,886	5,365	5,639	8,964	2,465
Gross profit or (loss)	437	560	715	836	984	1,300	370
General, selling, and administrative expenses	294	366	333	283	305	527	148
Net operating profit or (loss)	143	194	382	553	679	772	221
Other income or (expense).							
Net interest income or expense	(117)	(153)	(91)	(103)	(161)	(225)	(58)
All other income or (expense)[3]	(73)	52	(36)	(50)	(53)	(34)	(15)
Total other income or (expense)[4]	(190)	(101)	(127)	(154)	(213)	(259)	(72)
Net profit or (loss) before taxes	(47)	93	255	399	466	513	149
Depreciation and amortization	217	248	249	216	239	427	120

[1] Certain respondents included financial information on related products.

[2] Including nonitemized costs.

[3] Certain respondents report extraordinary and nonrecurring expenses.

[4] Including nonitemized income or expenses.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table H-5

Steel: Key financial ratios of U.S. minimills, by specified periods

Item	July 1, 1984-June 30, 1985	July 1, 1985-June 30, 1986	July 1, 1986-June 30, 1987	July 1, 1987-June 30, 1988	July 1, 1988-June 30, 1989	Jan. 1, 1989-Dec. 31, 1989	Jan. 1, 1990-Mar. 31, 1990
	(Percent of total net sales)						
Net sales:							
Excluding intracompany and intercompany transfers	92.8	93.6	92.6	94.2	94.1	93.5	93.7
Intracompany and intercompany transfers	7.5	6.4	7.4	5.8	5.9	6.5	6.3
Total net sales	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cost of goods sold (including intracompany and intercompany transfers):							
Raw materials	36.5	34.8	32.1	34.0	41.1	40.1	39.3
Direct labor	15.8	14.9	14.3	13.8	9.9	12.1	13.1
Other factory costs, including depreciation and amortization	39.3	40.4	40.8	38.7	34.1	35.1	34.6
Total cost of goods sold[1]	91.6	90.1	87.2	86.5	85.1	87.1	87.0
Gross profit or (loss)	8.4	9.9	12.8	13.5	14.9	12.7	13.0
General, selling, and administrative expenses	5.6	6.4	5.9	4.6	4.6	5.1	5.2
Net operating profit or (loss)	2.7	3.4	6.8	8.9	10.3	7.5	7.8
Other income or (expense):							
Net interest income or expense	(2.2)	(2.7)	(1.6)	(1.7)	(2.4)	(2.2)	(2.0)
All other income or (expense)	(1.4)	0.9	(0.6)	(0.8)	(0.8)	(0.3)	(0.5)
Total other income or (expense)	(3.6)	(1.8)	(2.3)	(2.5)	(3.2)	(2.5)	(2.5)
Net profit or (loss) before taxes	(0.9)	1.6	4.6	6.4	7.0	5.0	5.3
Depreciation and amortization	4.2	4.4	4.4	3.5	3.6	4.2	4.2

[1] Estimated by the staff of the U.S. International Trade Commission based on partial company responses.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Steel: Financial experience of U.S. specialty steel producers, by specified periods[1]

(1,000,000 dollars)

Item	July 1, 1984-June 30, 1985	July 1, 1985-June 30, 1986	July 1, 1986-June 30, 1987	July 1, 1987-June 30, 1988	July 1, 1988 June 30, 1989	Jan. 1, 1989-Dec. 31, 1989	Jan. 1, 1990-Mar. 31, 1990
Net sales:							
Excluding intracompany and intercompany transfers	2,362	2,039	2,269	3,263	4,253	4,712	1,090
Intracompany and intercompany transfers	190	46	158	243	366	189	44
Total net sales	2,552	2,085	2,426	3,506	4,619	4,902	1,134
Cost of goods sold (including intracompany and intercompany transfers):							
Raw materials	586	413	429	861	1,309	1,667	334
Direct labor	277	207	239	329	329	581	150
Other factory costs, including depreciation and amortization	1,067	662	818	952	1,008	1,120	298
Total cost of goods sold[2]	2,347	1,934	2,178	2,962	3,752	4,059	946
Gross profit or (loss)	205	151	248	544	867	843	187
General, selling, and administrative expenses	224	119	166	186	252	250	65
Net operating profit or (loss)	(19)	32	82	358	615	593	122
Other income or (expense):							
Net interest income or expense	(35)	(24)	(57)	(47)	(51)	(38)	(16)
All other income or (expense)[3]	(18)	(52)	(3)	(15)	(22)	(32)	(9)
Total other income or (expense)[4]	(54)	(76)	(60)	(62)	(73)	(70)	(25)
Net profit or (loss) before taxes	(73)	(44)	22	295	542	523	97
Depreciation and amortization	76	62	80	97	70	85	21

[1] Certain respondents included financial information on related products.

[2] Including nonitemized costs.

[3] Certain respondents reported extraordinary and nonrecurring expenses.

[4] Including nonitemized income and expenses.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table H-7

Steel: Key financial ratios of U.S. specialty steel producers, by specified periods July 1, 1984-Mar. 31, 1990

(Percent of total net sales)

Item	July 1, 1984-June 30, 1985	July 1, 1985-June 30, 1986	July 1, 1986-June 30, 1987	July 1, 1987-June 30, 1988	July 1, 1988-June 30, 1989	Jan. 1, 1989-Dec. 31, 1989	Jan. 1, 1990-Mar. 31, 1990
Net sales:							
Excluding intracompany and intercompany transfers	92.6	97.8	93.5	93.1	92.1	96.1	96.1
Intracompany and intercompany transfers	7.4	2.2	6.5	6.9	7.9	3.9	3.9
Total net sales	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cost of goods sold (including intracompany and intercompany transfers):							
Raw materials	27.9	29.9	25.9	34.0	40.2	41.0	35.7
Direct labor	13.3	14.9	14.5	13.0	10.1	14.3	16.0
Other factory costs, including depreciation and amortization	50.8	47.9	49.4	37.5	30.9	27.8	31.8
Total cost of goods sold[1]	92.0	92.7	89.8	84.5	81.2	82.8	83.5
Gross profit or (loss)	8.0	7.3	10.2	15.5	18.8	17.2	16.5
General, selling, and administrative expenses	8.8	5.7	6.9	5.3	5.4	5.1	5.8
Net operating profit or (loss)	(0.8)	1.5	3.4	10.2	13.3	12.1	10.8
Other income or (expense):							
Net interest income or expense	(1.4)	(1.2)	(2.4)	(1.3)	(1.1)	(0.8)	(1.4)
All other income or (expense)	(0.7)	(2.5)	(0.1)	(0.4)	(0.5)	(0.7)	(0.8)
Total other income or (expense)	(2.1)	(3.7)	(2.5)	(1.8)	(1.6)	(1.5)	(2.2)
Net profit or (loss) before taxes	(2.9)	(2.1)	0.9	8.4	11.7	10.7	8.6
Depreciation and amortization	3.7	3.0	3.3	2.8	1.5	1.7	1.9

[1] Estimated by the staff of the U.S. International Trade Commission based on partial company responses.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table H-8

Steel: Financial experience of U.S. converters, by specified periods[1]

(1,000 dollars)

Item	*Jan. 1, 1989-Dec. 31, 1989*	*Jan. 1, 1990-Mar. 31, 1990*
Net sales:		
Excluding intracompany and intercompany transfers	6,255,501	1,498,215
Intracompany and inter-company transfers	347,787	82,081
Total net sales	6,603,288	1,580,296
Cost of goods sold (including intra-company and inter-company transfers):		
Raw materials	3,736,907	888,541
Direct labor	392,140	93,762
Other factory costs, including depreciation and amortization	1,025,064	254,154
Total cost of goods sold[1]	5,782,207	1,374,885
Gross profit or (loss)	821,081	205,411
General, selling, and administrative expenses	482,199	121,188
Net operating profit or (loss)	338,882	84,223
Other income or (expense):		
Net interest income or expense	(120,324)	(29,595)
All other income or (expense)	19,601	5,135
Total other income or (expense)	(100,723)	(24,460)
Net profit or (loss) before taxes	238,159	59,763
Depreciation and amortization	140,805	36,791

[1] Certain respondents included financial information on related products.

[2] Including nonitemized costs.

[3] Certain respondents reported extraordinary and non-recurring expenses.

[4] Including nonitemized income and expenses.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table H-9

Steel: Key financial ratios of U.S. converters, by specified periods, Jan. 1, 1989-Mar. 31, 1990

(Percent of total net sales)

Item	*Jan. 1, 1989-Dec. 31, 1989*	*Jan. 1, 1990-Mar. 31, 1990*
Net sales:		
Excluding intracompany and intercompany transfers	94.7	94.8
Intracompany and inter-company transfers	5.3	5.2
Total net sales	100.0	100.0
Cost of goods sold (including intra-company and inter-company transfers):		
Raw materials	63.5	62.6
Direct labor	6.7	6.5
Other factory costs, including depreciation and amortization	17.4	17.9
Total cost of goods sold[1]	87.6	87.0
Gross profit or (loss)	12.4	13.0
General, selling, and administrative expenses	7.3	7.7
Net operating profit or (loss)	5.1	5.3
Other income or (expense):		
Net interest income or expense	(1.8)	(1.9)
All other income or (expense)	0.3	0.3
Total other income or (expense)	(1.5)	(1.6)
Net profit or (loss) before taxes	3.6	3.8
Depreciation and amortization	2.1	2.3

[1] Estimated by the staff of the U.S. International Trade Commission based on partial company responses.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

APPENDIX I
MAJOR COMPANIES' NET INCOME AND CASH FLOW-DATA
OCTOBER 1, 1988-SEPTEMBER 30, 1989

Table I-1

Calculation of major companies' net income from steel product operations, Oct. 1, 1988-Sept. 30, 19

(1,000 dollars)

Item	*Calcula*
Net sales	26,141
Cost of goods sold	22,816
General, selling, and administrative expenses	1,316
Interest expense	307
Reserves, provisions, special charges and other unusual items	139
All other expenses or (income)	1
Current income taxes	390
Tax effect of operating loss carry forward	(240.
Investment tax credit refund	(14.
Deferred taxes	3
Net income from steel operations	1,421

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commissi

Table I-2

Sources and uses of cash and cash equivalents in steel product operations, October 1, 1988-September 30, 1989

(1,000 dollars)

Item	*Calcula*
Cash provided from (cash used in) operations:	
Net income	1,421
Depreciation, depletion, and amortization	1,138
Non-cash income tax expense	6
Non-cash charges (credits):	
Relating to reserves, provisions, special charges and other unusual items	13
Other	117
Cash flow from earnings	2,697
Changes in working capital, excluding financing activities	(114.
Cash flow from operations	2,582
Cash provided from (used in) financing activities:	
Net additions to or (reductions) in long and short term debt	(871.
Changes in capital stock	2
Transfers from or (to) corporate	(165.
Other	(45.
Subtotal	(1,079.
Investment,[1] dividends paid, and other cash provided (used)	(1,264.
Increase (decrease) in cash and cash equivalents	238
Cash and cash equivalents:	
Beginning of period[2]	1,138
End of period[2]	1,376

[1] Includes capital expenditures and cash generated from the disposal of assets.

[2] Does not include data by USX.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commiss

Table I-3

Calculation of major companies' cash flow on steel product operations,[1] Oct. 1, 1988-Sept. 30, 1989

(1,000 dollars)

Item	*Calcul*
Cash flow from earnings	$2,697
Net changes in long and short term debt and, liabilities[2]	(986.
Dividends paid	(243.
Net cash flow from steel product operations[3]	1,467

[1] Under Public Law 98-573, section 806 (b)(2)(B) net cash flow is defined as "annual net (after-tax) incom depreciation, depletion allowances, amortization, and changes in reserves minus dividends and payments on short-term and long term debt and liabilities." The Conference report on the bill states that payment on short long term debt and other liabilities means the net reduction in such debt and liabilities.

[2] Includes net changes in working capital.

[3] Including net income pertaining to prior periods and net increases in debt and liabilities, exclusion of which reduce cash flow to $810.9 million.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commiss

Table I-4

Major U.S. steel companies: Net cash flow from steel product operations, Oct. 1, 1988-Sept. 30, 1989

(1,000 dollars)

	Net cash flow[1]	*Net income (loss) pertaining to prior period*	*Net increase in short and long term debt and liabilities*[2]
Armco			
Bethlehem			
Inland			
LTV			
National			
Rouge	*	*	*
USX			
Weirton			
Wheeling-Pittsburgh			
Total	1,467,324	213,705	158,762

[1] Including net income pertaining to prior periods and net increases in long and short debt and liabilities.

[2] Includes net changes in working capital.

[3] * * *

[4] * * *

[5] * * *

[6] * * *

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table I-5

Major U.S. steel companies: Net cash flow from steel-product operations, and steel-related expenditures, Oct. 1, 1988-Sept. 30, 1989

(1,000 dollars)

Company	Net cash flow (1)	Steel related expenditures: Plant and equipment (2)	Research and development[1] (3)	Retraining workers[1] (4)	Other (5)	Total expenditures (6)	Expenditures reflected in net cash flow[2] (7)	Net expenditures (6 - 7) (8)	Net increases in debts and liabilities (9)	Adjusted net cash flow (1 + 4 - 9) (10)	Expenditures for retraining workers as a percent of adjusted net cash flow (11)
Armco											
Bethlehem											
Inland											
LTV											
National											
Rouge											
USX											
Weirton											
Wheeling-											
Pittsburgh ..											
Total	1,467,324[6]	1,703,705	109,758	61,911	98,321	1,973,695	197,025	1,776,670	158,762	1,370,473	4.5

[1] Included as expenses in net income calculations.

[2] Estimated assuming funds used for research and development and for worker retraining will be reflected in net cash flow.

[3] Not applicable; net decreases.

[4] Not applicable; net cash flow was negative.

[5] Includes net increases in short term debt and liabilities of $158,760,000.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Major U.S. steel companies: Net cash flow from steel product operations, and steel related expenditures, June 1, 1990-Sept. 30, 1990 (estimate)

(1,000 dollars)

Company	Net cash flow (1)	Steel related expenditures: Plant and equipment (2)	Research and development[1] (3)	Retraining workers[1] (4)	Other (5)	Total expenditures (6)	Expenditures reflected in net cash flow[2] (7)	Net expenditures (6 - 7) (8)	Net increases in debts and liabilities (9)	Adjusted net cash flow (1 + 4 - 9) (10)	Expenditures for retraining workers as a percent of adjusted net cash flow (11)
Armco											
Bethlehem											
Inland											
LTV											
National	*	*	*	*	*	*	*	*	*	*	*
Rouge											
USX											
Weirton											
Wheeling-Pittsburgh ..											
Total	177,773	724,558	42,479	25,410	49,924	842,371	67,889	774,482	(3)	203,183	12.5

[1] Included as expenses in net income calculations.
[2] Estimated assuming funds used for research and development and for worker retraining will be reflected in net cash flow.
[3] Not available.
[4] Not applicable; net cash flow is expected to be negative.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.