Industry & Trade Summary

Semifinished Steel

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PREFACE

In 1991, the United States International Trade Commission initiated its current *Industry and Trade Summary* series of informational reports on the thousands of products imported into and exported from the United States. Each summary addresses a different commodity/industry area and contains information on product uses, U.S. and foreign producers, and customs treatment. Also included is an analysis of the basic factors affecting trends in consumption, production, and trade of the commodity, as well as those bearing on the competitiveness of U.S. industries in domestic and foreign markets.[1]

This report on semifinished steel covers the period 1988 through 1992 and represents one of approximately 250 to 300 individual reports to be produced in this series during the first half of the 1990s. Listed below are the individual summary reports published to date on the minerals, metals, and miscellaneous manufactures sector.

USITC publication number	*Publication date*	*Title*
2426	November 1991	Toys and models
2475	July 1992	Fluorspar and certain other mineral substances
2476	January 1992	Lamps and lighting fittings
2504	November 1992	Ceramic floor and wall tiles
2523	June 1992	Prefabricated buildings
2587	January 1993	Heavy structural steel shapes
2623	April 1993	Copper
2653	June 1993	Glass containers
2692	November 1993	Refractory ceramic products
2694	November 1993	Flat glass and certain flat glass products
2738	February 1994	Structural ceramic products
2742	March 1994	Fiberglass products
2748	March 1994	Brooms, brushes, and hair-grooming articles
2757	March 1994	Builders hardware
2758	March 1994	Semifinished steel

[1] The information and analysis provided in this report are for the purpose of this report only. Nothing in this report should be construed to indicate the determinations the Commission would make in an investigation conducted under statutory authority covering the same or similar subject matter.

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INTRODUCTION

This report analyzes the U.S. semifinished steel industry. Because all finished steel products pass through a semifinished stage, this report covers all steelmakers, but focuses only on steelmaking operations through the production of the semifinished steel. Although these operations vary from one producer to another, they are collectively referred to as primary stage operations.

Many of the most important changes affecting the steel industry are those affecting primary stage operations. Most semifinished steel products are consumed internally by steel producers; few enter open-market trade. However, the cost of semifinished steel constitutes a high percentage of the value of the finished steel products that are traded.[1] Environmental legislation is challenging the industry to develop cleaner and more efficient steelmaking processes, while interfirm rivalry and competition from substitute materials are forcing steelmakers to invest in cost-saving and quality-enhancing technologies.

Environmental regulations primarily affect the steel melting stage of steelmaking and, consequently, semifinished production. Although all steelmakers will be forced to cope with tightening regulations on environmental control, in the short term, it is likely that increased regulation of coke oven emissions under the Clean Air Act Amendments of 1990 will disproportionately affect integrated steelmakers. For electric arc furnace (EAF) steelmakers, the primary issue for the future is the availability of quality scrap. As minimills move into production of higher quality steel products, steel purity becomes increasingly important. In an attempt to insure quality, several mills are supplementing their use of scrap with purer forms of iron, such as direct-reduced iron (DRI) and iron carbide.

In view of the high cost of most new equipment and the relatively long lead time necessary to bring new equipment on stream, changes in production methods and products generally can be made only gradually. Even new process technologies that fundamentally change the industry, such as continuous casting technologies (described below), are adopted only over long periods of time. This is because installation of major pieces of new steelmaking equipment may cost millions of dollars and require additional retrofitting of other plant and equipment. The payback period for an investment in a new technology can be many years. Given the recent financial performance of the steel industry and certain recent reported difficulties in raising funds in the bond market, the ability to raise the capital needed to purchase such equipment is limited.

In the long term, the steel industry will likely continue to move towards more simplified and continuous primary stage technologies that reduce the capital costs for new mill construction, allowing smaller mills to operate efficiently. The companies that excel in this environment will be those that have the resources and foresight to invest in such technologies.

[1] Approximately 85-90 percent of the cost of hot-rolled steel and 60-75 percent of the cost of cold-rolled steel are incurred during the primary stage operations.

Product Description

Semifinished steel products[2] are the first solid forms of molten steel, and usually represent the rough stock from which finished steel mill products are formed. Semifinished steel can take several forms, categorized as ingots, blooms, billets, or slabs. In addition, semifinished steel can also vary by composition (or grade). Although there are hundreds of grades of standard steels and many more proprietary grades, the industry generally classifies steel as carbon, alloy, or stainless.[3] This report covers carbon and alloy grades, but excludes stainless and tool steels, which will be covered in a forthcoming summary.

Ingots are large castings resulting from the solidification of molten steel (figure 1). The castings vary by cross-sectional dimension, shape, and amount by which the steel has been deoxidized.[4] They are generally further rolled into blooms, billets, and slabs, which are collectively referred to as semifinished shapes. Some ingots are not used to make semifinished shapes, but instead are forged directly into shafts for power plants, nuclear plant components, and other products.

Among semifinished shapes, distinctions are made according to size, dimensions, and intended use. Blooms and billets are used in the production of non-flat steel products. Since blooms are larger than billets, they are used as the feedstock for the heavier non-flat products (medium and heavy structural shapes, rails, and sheet piling), whereas billets are the feedstock for bars, light structurals, wire rod, and tube rounds for seamless pipe.

Both are generally of rectangular, square, or circular cross section, have a length several times greater than the maximum cross-sectional dimension, and, if rectangular, a width less than four times the thickness (figure 1).

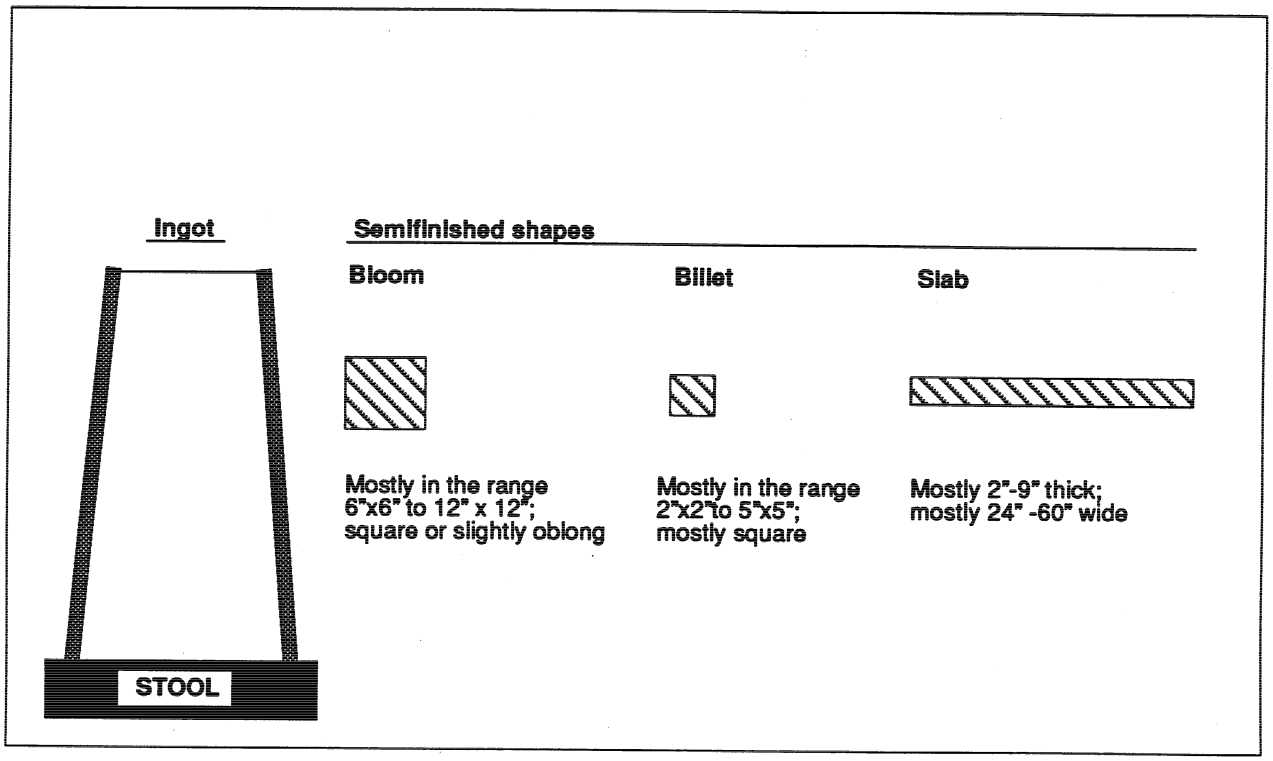
Unlike blooms and billets, slabs have cross-sectional proportions that are more oblong than square (figure 1), as their width is at least four times their thickness. They are used in the production of flat

[2] The semifinished steel industry is covered by Standard Industrial Product Classification Code 3312213 (carbon) and 3312231, 3312236, and 3312239 (alloy).

[3] Carbon steel, the most common grade of steel, contains alloying elements (e.g., manganese, lead, nickel) under specified limits, whereas alloy steel contains alloying elements exceeding those limits. The alloys impart properties to the steel (e.g., strength, hardness, electrical conductivity) that are appropriate for a specified end use. By convention, the term "alloy steel" excludes stainless steel, which is a type of alloy steel that, because of its high chromium content, is particularly corrosion-resistant. Tool steel is also excluded.

[4] United States Steel, *The Making, Shaping and Treating of Steel*, 10th ed., (Pittsburgh: Association of Iron and Steel Engineers, 1984), pp. 691-699.

Figure 1
Typical cross-section of semifinished steel



Source: Constructed from information presented in United States Steel, *The Making, Shaping, and Treating of Steel,* 10th ed., pp. 693 and 701.

products (sheet, strip, and plate) and skelp, which is used for forming welded pipe.

Production Process

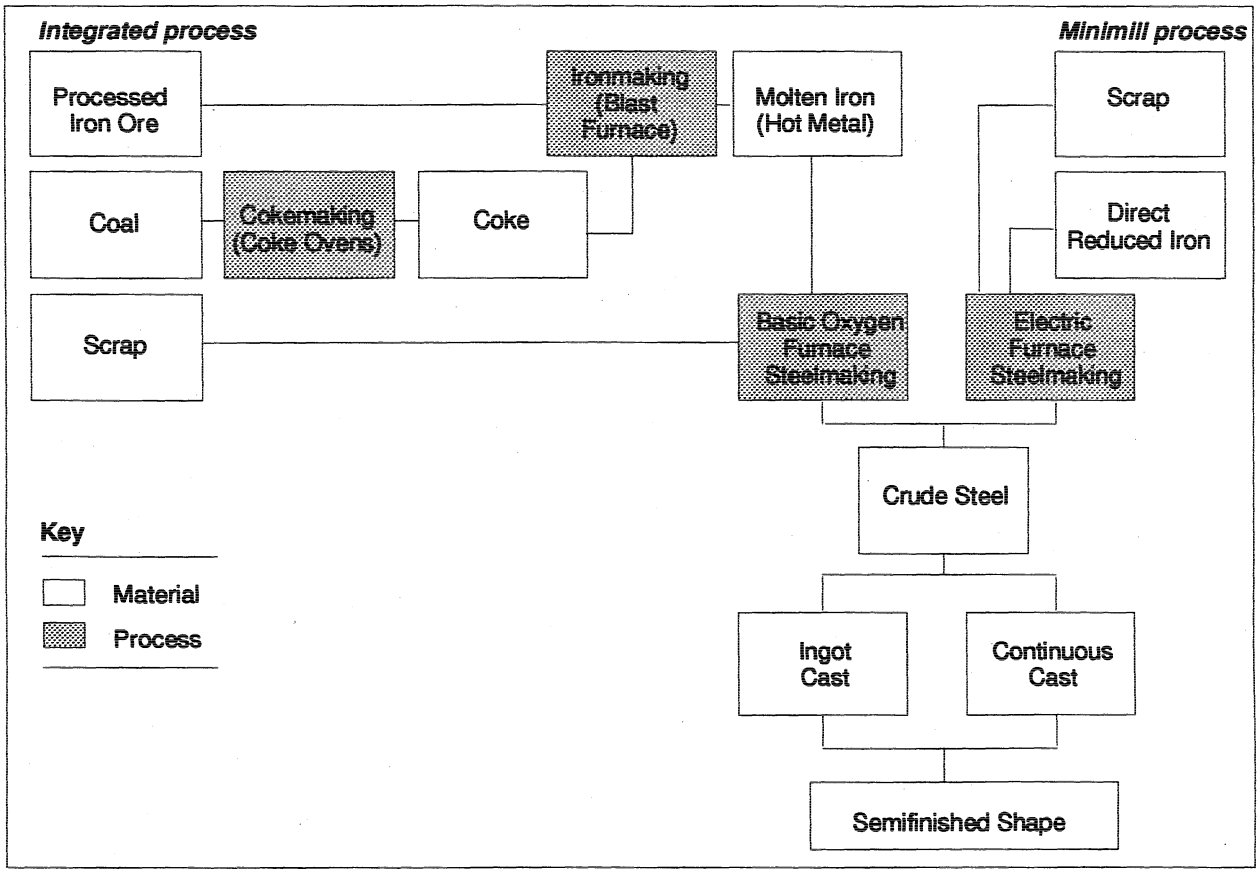
The production of semifinished steel begins with the production of molten steel, which is produced either by the integrated or nonintegrated process (figure 2). The nonintegrated process, which is used primarily by small mills, referred to as minimills, produces molten steel by melting steel scrap in an electric arc furnace (EAF). Integrated producers, on the other hand, smelt iron ore and coke (a processed form of coal) in a blast furnace to produce molten iron, which is subsequently poured, along with some steel scrap, into a steelmaking furnace, generally a basic oxygen furnace (BOF). The hot metal is refined into steel when oxygen is blown into the metal bath, where it combines with excess carbon. Lime is added to serve as a fluxing agent; it combines with impurities (oxidized carbon and other elements) to form a floating layer of slag, which is later removed.

Once molten steel with the correct metallurgical properties has been produced, it is cast into a form that can enter the rolling process. Currently the industry uses two principal methods of casting: ingot teeming and continuous casting (figure 3). Ingot teeming is the traditional and less efficient process, in which steel is poured into large individual molds, allowed to solidify, and then separated from the molds. The resulting steel ingots are placed in soaking pits where they are heated until they reach a uniform temperature. The reheated ingots are then rolled in a primary breakdown mill into blooms, billets, and slabs. In 1992, slightly less than one-quarter of crude steel in the United States was cast using the ingot teeming method.

Continuous cast steel accounts for more than 75 percent of the crude steel that was cast in the United States in 1992 compared with approximately 30 percent in 1982.[5] The continuous casting process bypasses several steps of the conventional ingot teeming process by casting steel directly into semifinished shapes. Molten steel is poured into a reservoir (called a tundish) from which it is released into the molds of the casting machine. The steel is cooled as it descends through the molds, and before emerging, a hardened outer shell is formed. As the semifinished shapes proceed on the runout table, the center also solidifies, allowing the cast shape to be cut into lengths. In terms of operating efficiency, continuous casting reduces the operating costs of

[5] American Iron and Steel Institute.

Figure 2
Simplified steelmaking flowchart



Source: Constructed from information presented in United States Steel, *The Making, Shaping, and Treating of Steel*, 10th ed., 1985.

producing semifinished steel by 12 to 18 percent.[6] It does this primarily by increasing yield (ratio of cast steel to molten steel), decreasing energy consumption, and employing less labor. In addition, continuous casting improves quality and reduces input requirements and pollution.

In the process of heating, rolling, and casting, semifinished shapes can acquire some imperfections, particularly if formed through the ingot-teeming process. Defects are removed primarily by scarfing and grinding. Scarfing involves the use of a torch to burn off surface impurities. Defects can also be removed by applying a grinding stone to the surface.

[6] Calculated by USITC staff based on statistics in Donald F. Barnett, "New Technologies for a New Century," a presentation to the Steel Survival Strategies VI conference, New York, June 18-19, 1991.

U.S. INDUSTRY PROFILE

Industry Structure

Producers of Semifinished Steel

Nearly 60 firms produce semifinished steel in the United States. Almost all use their semifinished steel in the captive production of finished steel products. Only 2-3 percent of semifinished steel was actually sold on the market during 1989-91.[7] Thus, semifinished steel producers are generally steel companies that produce and sell only finished steel products. Only a few small U.S. steel producers are dedicated exclusively to the production and sale of semifinished steel.[8]

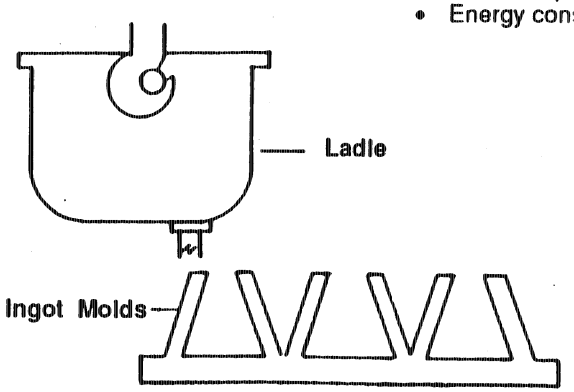
[7] This percentage varies slightly among different types of semifinished products, but is generally low for each.

[8] Among companies reporting shipments to the American Iron and Steel Institute, the following reported only shipments of semifinished steel in 1991: Ocean States Steel, First Miss Steel, National Forge, Edgewater, A. Finkl, E.M. Jorgensen, Standard Steel, Union Electric Steel.

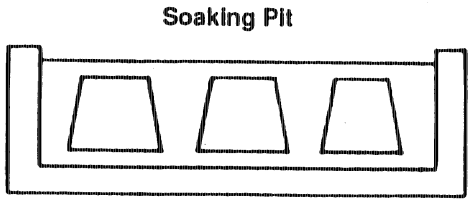
Figure 3
Flow chart of steel casting; Ingot casting vs. continuous casting

Ingot Casting Method

- Producing slab from liquid steel requires approximately .90 –1.10 manhours per ton.
- Yield of liquid steel to slab is typically 79 percent.
- Energy consumed to produce slab is typically 13.5 million btu/ton.

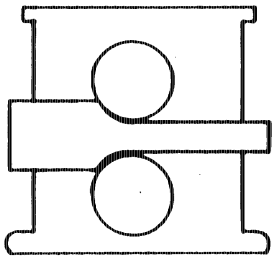


Molten steel from ladle is poured into ingot molds.



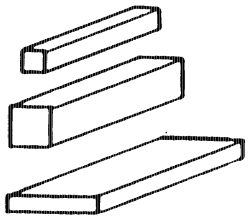
Soaking Pit

After being stripped from molds, ingots go to soaking pit for uniform heating



Breakdown Mill

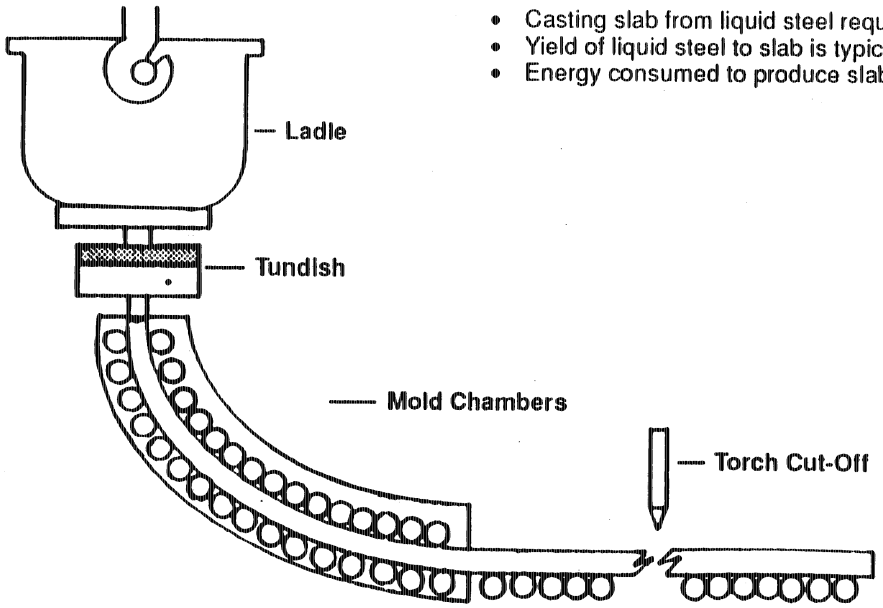
Ingots pass through primary breakdown or roughing mill.

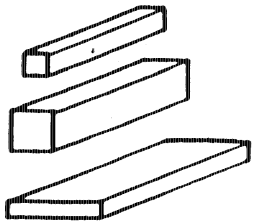


Semifinished Shape

Continuous Casting Method

- Casting slab from liquid steel requires approximately .35–.50 manhours per ton
- Yield of liquid steel to slab is typically 97 percent.
- Energy consumed to produce slab is typically 11.8 million btu/ton.





Semifinished Shape

Molten steel from ladle is poured into ingot tundish, and then flows continuously into the molds. When the steel emerges from the mold, a hardened outer shell allows it to maintain its form.

Source: Constructed from information presented by Dr. Donald Barnett, Economic Associates, Inc.

Several companies have stated that they sold surplus semifinished products on the open market, but few do so regularly. Instead, most try to enter the market when steel demand is low (and the market for their finished steel output has diminished) and exit the market when steel demand is high (and the company would rather roll all the steel it can melt).

Industry Concentration

Semifinished steel producers are concentrated geographically in the Great Lakes region, where the integrated steel companies based their operations. Several minimills also operate in this region. The South is the next largest steel-producing region, although there are only two integrated steel plants (Gulf States Steel and USS-Fairfield). Steel production in the western United States is limited to one integrated plant (Geneva Steel) and a small number of minimills.

Although the steel industry has traditionally been regarded as oligopolistic, competitive conditions in the industry have changed.[9] In 1992, the top four firms produced 38 percent of the nation's crude steel, and the top eight produced 52 percent. By contrast, 10 years earlier, the top four firms produced 48 percent and the top eight firms 74 percent. The decrease in industry concentration reflects the entrance of minimills into the industry and substantial downsizing on the part of integrated producers.

Another important change in the industry's structure is its decreased vertical integration. Steel companies, particularly integrated companies, traditionally owned a stake in coal, iron ore, or scrap suppliers, raw materials transportation operations, and downstream fabricating and distribution facilities. In the course of restructuring in the 1980s, however, many sold off their interests in raw materials and transportation enterprises to focus scarce capital resource on their steelmaking operations.

Foreign Investment in the U.S. Steel Industry

Foreign steelmakers acquired interests in and injected considerable new funds into the U.S. steel industry in the mid- to late-1980s. Much of the investment was in rolling or coating[10] facilities, and even service centers and distribution outlets, but a sizeable amount involved primary stage steelmaking operations (table 1). By providing needed capital and technology, foreign steel companies facilitated the upgrading of numerous aging U.S. facilities and the installation of capacity in new higher-value-added product lines.

The investment came in several forms. In some instances, foreign producers took an equity position in an established steel company or particular steelmaking facility. Notable examples are NKK's 70-percent equity position in National Steel and Kawasaki Steel's 50-percent ownership position in Armco Steel Co. L.P. Other foreign investment took the form of joint ventures in greenfield sites, though most of those were in steel-processing facilities, particularly coating lines. The one greenfield joint venture site that involves primary stage operations is the structural steel facility built in 1989 in Blytheville, Arkansas, and jointly owned by Nucor Steel and Japan's Yamato Kogyo Steel.

Japanese steel companies were the most active investors. Each of the major Japanese producers is involved with at least one of the major U.S. steel companies. As investment by the Japanese slowed in the late 1980s, steel producers from Europe, particularly state-owned Usinor-Sacilor of France, began to invest in the U.S. steel industry. Other investors included steel companies from Brazil, Canada, China, and Korea.

Pricing

Because the market for semifinished steel products is small relative to that for finished steel products, the price for semifinished steel is not published in the trade press. However, conversations with industry representatives indicate that U.S. prices for semifinished steel fell along with prices for most finished steel products during 1991 and 1992.[11]

In the relatively limited semifinished steel market, the consumer is likely also to be the supplier's competitor (in sales of finished steel); thus, the dynamics of pricing operate differently than for finished steel products. A steelmaker with excess melting capacity may have incentive to refrain from selling semifinished steel at a price that would allow the (competitor) consumer to produce a finished steel product at a lower cost. This could happen when the consumer's cost of rolling the semifinished shape is lower than the supplier's cost. Thus, the semifinished sales price would reflect not just the supplier's production cost, but the customer's cost of processing the semifinished steel.[12]

Employment, Productivity, and Compensation

As the steel industry restructured in the 1980s, the closure of steelmaking facilities resulted in the lay-off of tens of thousands of workers. At about 140,000 workers in 1992, steel industry employment is 14 percent below 1987 employment levels, and only about 50 percent of 1982 levels.[13] Approximately

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[9] For further information, see U.S. International Trade Commission, *Quarterly Report on the Status of the Steel Industry* (investigation No. 332-226), USITC publication 2465, Dec. 1991, pp. i-vii.

[10] Steel mill products may be coated with metals or nonmetallic substances to improve their aesthetics, to reduce the final product cost (in lieu of using more expensive base materials), and to improve their corrosion resistance.

[11] Representatives of various steel companies, interviews with USITC staff to gather background information on the semifinished steel industry, Mar. 13-14, 1992.

[12] Ibid.

[13] American Iron and Steel Institute, *Annual Statistical Report*, various years.

Table 1
Foreign equity investment in selected U.S. facilities involved in primary stage steelmaking operations[1]

Company	Foreign Partner/ Owner	Foreign Country	Share of Foreign Ownership	Start-up Date	Existing (E) or New (N)	Project or Asset
			(Percent)			
Al Tech Spec. Steel	Sammi Steel	South Korea	100	1989	E	All facilities in U.S. and Canada
Arkansas Steel	Sumitomo	Japan	25	1989	E	All facilities
Armco	Kawasaki	Japan	40	1989	E	Eastern Steel Division
Armco	Kawasaki	Japan	50	1990	E	Eastern Steel Division (increased owner ship)
Atlantic Steel	Ivaco	Canada	100	1979	E	All facilities
Auburn Steel	Ataka/Kyoei/Sumitomo	Japan	100	1977	E	Steelmaking facility in Auburn, NY
Connecticut Steel	Korf	Germany	100	1985	E	All facilities
Connecticut Steel	Von Moos Holding AG	Switzerland	(2)	1991	E	All facilities
CSC Industries-Copperweld	Daido Steel/Imetal SA	Japan/France	38/23	1989	E	Bar mill in Warren, OH
Hawaiian Western	Western Canada Steel	Canada	51	1959	E	Steelmaking facility in Hawaii
Inland Steel	Nippon Steel	Japan	13	1989	E	Purchase of equity share
J&L Specialty	Usinor-Sacilor	France	100	1990	E	All facilities
Laclede	Ivaco	Canada	51	1983	E	All facilities
National Steel	NKK	Japan	50	1984	E	All facilities
National Steel	NKK	Japan	70	1990	E	All facilities (increased ownership)
New Jersey Steel	Von Roll	Switzerland	100	1983	E	Steelmaking facility in Sayreville, NJ
Nucor Corp.	Yamato Kogyo	Japan	49	1989	N	Structural steel facility, Nucor-Yamato, in Blytheville, AK
Ocean State Steel	Von Moos Holding AG	Switzerland	(2)	1991	E	All facilities
Phoenix Steel	CITI-Steel	Peoples Republic of China	100	1989	E	Plate mill in Claymont, DE
Raritan River	Co-Steel	Canada	100	1980	E	Steelmaking facility in Perth Amboy, NJ
Slater Steel (Ft. Wayne Specialty)	Slater Industries	Canada	100	1980	E	Specialty bar mill
Tamco	Tokyo Steel/Mitsui	Japan	50	1977	E	Facility in Etiwanda, CA
USX	Kobe	Japan	50	1989	E	Steelmaking facility in Lorain, OH

[1] Excludes rolling, coating, and other processing facilities.

[2] Majority owner.

Source: Various issues of *American Metal Market*, *Metal Bulletin*, and *Steels Alert*.

35-40 percent of all steelworkers are involved in melting and casting operations.[14]

The downsizing of the workforce, the increased use of automation, and workforce training have significantly enhanced worker productivity, which is commonly measured in the number of manhours required to produce a ton of steel (mhpt). In 1986, labor productivity in steel melt shops (in terms of liquid steel production) typically ranged from 1.35 mhpt to 1.55 mhpt. By 1991, productivity ranged from 1.15-1.45 mhpt.[15]

As labor productivity increased, so did worker compensation. In 1992, steelworkers earned an average of almost $30 per hour (in current dollars, including benefits), compared with $24 per hour in 1987. This figure is fairly uniform among the large integrated producers, where long-term labor contracts are negotiated with the United Steelworkers of America. Compensation in minimills tends to be somewhat lower. In many cases, steel companies have introduced some form of profit-sharing plans and/or productivity based pay. At Nucor, for example, one-third of workers' compensation is based on a base hourly rate, one-third on a productivity rate, and one-third on company profit.

Research and Development

Much of the research and development in the U.S. steel industry focuses on the processes used in the production of semifinished steel. Progress in these areas has decreased operating and capital costs, increased steel quality, and reduced energy consumption and pollution. However, relative to many of its principal foreign competitors, the U.S. steel industry spends a relatively small amount on research and development. In 1992, U.S. steel industry expenditures for research and development totaled $158.0 million and represented 0.37 percent of net sales.[16]

To compensate, several U.S. producers have incorporated technologies developed overseas. Because the steel industry is global in nature, new technologies and processes developed in one country have in several cases been first implemented in another. The principal areas of ongoing research and development related to primary stage operations can be categorized in four major groups: cokemaking, ironmaking, steelmaking, and casting. Below is a discussion of ongoing efforts in each of these areas.

Cokemaking

Coke is the primary fuel for ironmaking in the blast furnace. It is produced by baking coal in the absence of air at about 2,000° Fahrenheit. The heat drives off volatile elements and the result is virtually pure carbon.

Coke ovens represent a major capital investment. To construct a new battery of coke ovens in the United States would cost an estimated $250-300 per ton of annual capacity; with an average capacity of 300,000 tons per year (tpy), the construction cost would reach $75-$90 million.[17] As many U.S. coke oven facilities are reaching the end of their useful life, which is estimated to be 30-35 years, several integrated producers face a decision on whether to rebuild their coke ovens, install new ones, or rely on purchases of coke in the open market.

A major factor in their calculation is that cokemaking continues to be a major source of pollution in the steel industry, even though coke oven emissions reportedly have fallen an average of 90 percent since enactment of the Clean Air Act in 1970.[18] Increasingly stringent environmental regulations (discussed below) make operations at existing coke plants more costly and are speeding up the closure of several coke ovens. From 1991 to 1992, 11 coke oven batteries were either shut down or were scheduled to be shut down.[19] Cokemaking capacity decreased from approximately 44 million tons in 1987 to 24 million tons in 1992.[20]

U.S. steelmakers are turning to new technologies to decrease either the sources of pollution or their reliance on coke. However, most of the research and development in this area is being conducted by companies outside the steel industry, that sell or license their technology to integrated steel companies or merchant coke producers.[21]

One company that is active in this area is the Sun Coal Company, whose "non-recovery" cokemaking process creates negative pressure (partial vacuum) inside the oven that prevents the escape of pollutants.

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[14] For further information, see U.S. International Trade Commission, *Steel Industry Annual Report on Competitive Conditions in the Steel Industry and Industry Efforts to Adjust and Modernize* (investigation No. 332-289), USITC publication 2226, Oct. 1989, p. 5.

[15] Dr. Donald F. Barnett, Economic Associates, Inc., telephone conversation with USITC staff, June 10, 1992. The range of labor productivity depends not only on operating efficiency, but on the amount of ore sintering and the amount of coke that is produced as opposed to purchased. Figures include direct (e.g., operating staff, maintenance) and indirect workers (e.g., management). The improvement of labor productivity from 1986-91 is understated by the above figures; as continuous casting increased, so did the proportion of hot metal (as opposed to steel scrap) added to the steelmaking furnace. The increased hot metal requires added labor.

[16] For further information, see U.S. International Trade Commission, *Steel Semiannual Monitoring Report*, investigation No. 332-327, USITC publication 2655, p. 25, June 1993.

[17] A.T. Peters, *The Effects of the Clean Air Act, Amendment of 1990 on the U.S. Coke and Steel Industry and Foreign Trade Balance*, (U.S. Bureau of Mines: Washington, Sept. 1991), pp. 9-10.

[18] Bruce Steiner, Vice President, Environmental and Energy Policy, American Iron and Steel Institute, telephone conversation with USITC staff, June 17, 1992.

[19] The shut-down coke oven batteries include three at USS Fairless Works, six at Inland, and one each at two merchant coke producers, Detroit Coke and Terre Haute Coke. Steiner interview, June 17, 1992.

[20] PaineWebber World Steel Dynamics, *Steel Strategist*, various issues.

[21] Alternative Cokemaking Technology Survey Task Group, *Alternative Cokemaking Technologies*, a report to the Committee on Technology of the American Iron and Steel Institute, Aug. 1991, p. 7. Merchant coke producers are manufacturers that operate independently from any steelmaking facility.

Heat, not by-product gases, is recovered and provides electrical energy for the ovens' operation. Excess energy can be sold to outside customers. Sun Coal's coke batteries in Van Sant, VA, which are the only non-recovery coke ovens in the United States, have a total production capacity of 600,000 tpy. Output is targeted to small blast furnace operators.[22] Although Inland Steel had planned a joint-venture with Sun Coal to build non-recovery coke batteries, the deal was canceled in early 1992, reportedly because Sun Coal opted for a different approach to marketing its technology.[23]

The most prominent technology to replace coke in the blast furnace is pulverized coal injection (PCI), which substitutes coal for coke as the blast furnace fuel. PCI technology can replace about 25-40 percent of coke in the blast furnace. Although Armco has used coal injection technology since the 1960s, no other U.S. firm adopted it for many years. In large part, adoption of PCI technology was limited by the high fixed capital costs of constructing a PCI facility. With capital costs estimated to be $100-110 per annual ton of capacity,[24] providing enough pulverized coal for one 1-million-tpy blast furnace would cost approximately $20-$22 million.[25]

More recently, interest in the pulverized coal technology has increased. U.S. Steel's Gary Works outfitted each of its four operating blast furnaces with pulverized coal injection equipment and it is expected that when operating at full-speed, one million tons of coke will be displaced annually.[26] Inland Steel installed PCI equipment at its largest blast furnace in September 1993. The annual coke displacement will be 600,000 tons.[27] Bethlehem Steel plans to begin a PCI project, partially funded by the U.S. Department of Energy, at its Burns Harbor, Indiana facility. This project differs slightly from the others because it will use granulated coal rather than pulverized coal. And finally, USS/Kobe Steel has announced its intention to add PCI capabilities to its two largest blast furnaces.[28]

Steel producers can also inject other fuels—natural gas, oil, and tar/pitch—instead of coke into the blast furnace, but these fuels generally can only replace coke in limited amounts. The most promising fuel appears to be natural gas, injection of which increases the productivity of the blast furnace. A 20-percent decrease in coke will increase blast furnace production by 10 percent.[29] Researchers have not been successful in injecting substantially greater amounts of natural gas.

Another potential partial substitute for coke is formcoke, which is a blend of coke with coal that has been baked at relatively low temperatures. The benefit of the formcoking process is that it is done in an enclosed vessel, allowing the pollution-bearing volatiles to be recovered and used to form products that can be sold. Steel companies have shown little interest in the technology, which has reportedly advanced little since the 1970s,[30] although a few non-steel companies have continued to work on formcoke technology.

Ironmaking

The focus of research and development in ironmaking is in direct reduction and smelting reduction technologies. Direct reduction technologies aim to concentrate the iron content of iron ore by operating below its melting point. Such technology operates without the need for coke. The solid iron produced in these processes, called direct-reduced iron (DRI), is well-suited for use in electric furnaces (which minimills rely on) and can be used in basic-oxygen furnaces (BOF) (used by integrated steelmakers) to increase the hot metal output rate as well as decrease coke consumption. In February 1992, Armco's Middletown, Ohio works began using DRI as a charge material in its blast furnace to provide additional hot metal that was needed to meet increased production demands (the demands did not justify operating another blast furnace).[31] Likewise, Bethlehem Steel's Burns Harbor, Indiana facility began using DRI in its BOFs as a coolant and as a supplemental pig iron supply.[32]

The only operating DRI production facility in the United States is owned by Georgetown Steel Corporation for use in its EAF steelmaking. Most DRI production intensively uses natural gas, and is therefore only commercially feasible in areas that benefit from low natural gas rates, such as many areas of the Middle East, Southeast Asia, and Venezuela.

In terms of smelting reduction technologies, the Corex process is the most successful. Developed by Korf Engineering in the early 1980s and owned by Deutsche Voest-Alpine Industrieanlagenbau GmbH, Corex technology has been in commercial operation at South Africa's ISCOR since 1989. Not only does the Corex process make use of coal instead of coke, but the range of acceptable coals is much broader than is the

[22] Alternative Cokemaking Technology Survey Task Group, p. 7.

[23] Inland Steel Industries, *Annual Report 1991*, p. 10. Peter Scolieri, "Inland Plans PCI Facility," *American Metal Market*, Mar. 19, 1992, pp. 2, 4.

[24] Jay C. Agarwal, et.al., "Natural Gas Fills Gap in Coke Decline," *American Metal Market Steelmaking Supplement*, Sep. 24, 1990, p. 30A.

[25] Calculated by USITC staff. Assumes 400 pounds of natural gas injected for each ton of hot metal produced.

[26] George E. Kuebler, "Coke Concerns Fuel Interest in PCI," *33 Metal Producing*, April 1993, p. 17.

[27] Ibid.

[28] Ibid., p. 20.

[29] Dr. Jay C. Agarwal, "Natural Gas Injection in the Blast Furnace: Results from the Armco Middletown Test Trials and the Significance to Future Ironmaking," a presentation to the annual meeting of the American Iron and Steel Institute, New York, May 28, 1992. It is not clear whether the productivity benefits also apply to PCI technology.

[30] Alternative Cokemaking Technology Survey Task Group, p. 7.

[31] *Direct from Midrex*, 3rd Quarter, 1992, volume 17, number 4, p. 11.

[32] George W. Hess, "DRI: Can Steel Tap Its Potential?", *Iron Age*, February 1990, p. 35.

case for the metallurgical coals used in cokemaking. The Corex process offers environmental benefits as well; there are low emissions and waste materials, and the export gas is clean and provides a source of energy for mill operations or outside customers.

One industry executive has stated that the small size of a Corex facility would make investment in such facilities costly for large, BOF-based producers.[33] ISCOR's Corex facility produces 1,000-2,000 tons of iron per day compared with the 8,000-12,000 tons of iron per day at a modern blast furnace. Therefore, several Corex facilities would be required to replace one blast furnace. A relatively small Corex facility with a capacity of 500,000 tpy would cost an estimated $150 million.[34] Thus, even if Corex offers lower operating costs, the capital costs make the investment difficult for companies that already have sufficient ironmaking capacity.

Therefore, Corex facilities are more likely to be a complement to, rather than a substitute for, blast furnace iron made by integrated steel producers. For minimills, on the other hand, the small size of the Corex facility is more attractive. It offers a relatively low-cost source of hot metal, which can be used to dilute scrap in an electric furnace, thereby increasing the purity of the resulting steel. This would help minimills achieve the steel quality needed to enter some of the high-value flat products markets.

The Australian CRA Ltd. and Midrex Corporation of North Carolina together have developed another direct smelting process known as Hismelt. A demonstration plant is being built in Australia with an annual capacity of 150,000 tons, with completion scheduled for 1995. The process uses a circulating fluid bed reactor for preheating and prereducing iron ore and coal. Hot blast air rather than oxygen is used for the initial combustion of the coal because the nitrogen in the air is believed to promote heat transfers and control post-combustion temperatures. Smelting begins with the bottom injection of coal, which is dissolved in the bath. The dissolved carbon is used to reduce the iron ore, releasing carbon monoxide which is post-combusted by injecting oxygen in the batch.[35]

Steelmaking

Several U.S. and Canadian integrated steel companies are engaged in a joint research effort sponsored by AISI and partially funded by the U.S. Department of Energy under The Metals Initiative, to take direct reduction one step further. The object of their research is to combine the smelting functions of the blast furnace and the oxidation processes of the steelmaking furnace in one vessel. The resulting hot metal would be transferred to another vessel where oxygen injection would remove the excess carbon. The oxidation would generate excess reducing gases, which would be directed back to the first reduction vessel as an energy source. If successful, this technology offers several benefits. It would: (1) eliminate the need for coke ovens and blast furnaces, thereby by-passing major pollution sources, (2) reduce capital costs required to build an integrated steel mill, (3) lower direct operating costs of steel by about $10-$20 per ton (a 5 to 15 percent savings), and (4) reduce energy requirements by about 20 percent.[36] AISI estimates that it will be 4 to 5 years before the first commercial direct steelmaking unit is built and an additional 15 to 20 years before significant capacity can be installed by the industry.[37]

Casting

The final area of R&D related to primary stage operations is casting technology. The replacement of ingot teeming with continuous strand casting has already been a major advancement (see Production Process section). The increased percentage of steel that is continuously cast has enhanced the competitiveness of the U.S. steel industry.

The goal of current research is to refine the casting process to produce semifinished shapes that more closely approximate their intended final form. "Near-net-shape" casting technology takes a variety of forms, and is currently being applied to beam blank casting, slab casting, and strip casting.

Near-net-shape casting has already been applied to commercial structurals production. Most structural shapes producers now cast steel into beam blanks rather than traditional square or rectangular blooms and billets. Beam blanks are "dogbone" shaped and approximate the final shape of a beam, making it easier to roll wide-flange beams and H-columns. Near-net-shape casting has been further refined by Chaparral Steel (Midlothian, TX), which produces blanks with a web half as thick as those of conventional beam blanks. By casting a relatively thin section, Chaparral reduces the amount of reheating and hot working needed, thus speeding up production and reducing energy costs.[38]

A more recent development is the building of commercial thin slab casting capacity. For example, whereas current continuous slab casters produce slabs that are about 9 inches thick, new thin slab casters produce slabs that are 2 inches thick. Thin slabs do not have to pass through as many rolling mills as conventional slabs to reach the desired gauge (thickness). Currently there are two different processes

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[33] William Jolley, "Steel Technological Revolution," a presentation at the Steel Survival Strategies VI conference, New York, June 18-19, 1991.

[34] A.T. Peters, *The Effects of the Clean Air Act, Amendment of 1990 on the U.S. Coke and Steel Industry and Foreign Trade Balance*, (U.S. Bureau of Mines: Washington, Sept. 1991), p. 5.

[35] George J. McManus, "The Direct Approach to Making Iron," *Iron Age*, July 1993, p. 24.

[36] AISI Direct Steelmaking brochure.

[37] AISI, *The Steel Industry and Global Climate Change*, Factsheet, May 19, 1992.

[38] For more information on beam-blank casting and its impact on efficiencies in structurals production, see U.S. International Trade Commission, *Industry & Trade Summary: Heavy Structural Steel Shapes*, USITC publication 2587, Jan. 1993.

that have been utilized in commercial thin slab casting: Compact Strip Production (CSP)[39] and In-Line Strip Production (ISP).[40] Although the two processes contain some unique features, both are designed to use electric furnace steel to produce very thin slabs that can enter the rolling phase of steel production immediately after casting. Thin slab facilities offer various advantages over traditional slab or ingot casting facilities, including more economies of scale, capital savings, speed of construction, and ease of incremental growth and development.

Nucor Steel was the first U.S. mill to adopt the new technology, starting up a 900,000 tpy ISP CSP facility in Crawfordsville, IN in 1989 and a 1.2 million tpy CSP facility in Hickman, AR in 1992. Nucor has also announced a 1.0 million tpy joint venture with Oregon Steel, to be located on the West Coast. Other U.S. mills reportedly considering installing this new technology include North Star Steel, Chaparral Steel, and Birmingham Steel. One industry analyst predicts that by the year 2000 there will be 4 to 5 thin slab/flat-rolling mills in the United States with a combined capacity of about 8 million tpy.[41] The United States is not alone in pursuing the new technology: thin slab casters are currently in commercial operation in Italy (Arvedi) and additional capacity is planned in Canada (Dofasco) and Mexico (Hylsa).

Steelmakers are working on the development of direct strip casting, in which steel slabs would be cast at even thinner gauges. Allegheny Ludlum and Voest-Alpine are currently operating a commercial scale machine in the United States under the trademark CoilCast.[42] If successful, the direct strip operation will allow the casting of steel directly into the form of sheet and strip, thereby by-passing the hot strip mill. Because hot strip mills represent a major investment, direct strip casting would substantially lower the capital costs of constructing a sheet steel facility. Furthermore, the process efficiencies would significantly lower the operating costs of producing sheet steel.

Certain steel producers hope to further refine near-net-shape production through the use of spray deposition, also known as spray forming. The spray forming process, developed by Osprey Ltd., is a near-net-shape process in which liquid metal is atomized by gas and sprayed on a preform at a very rapid rate. This process results in a finer grain structure and substantial equipment cost savings over traditional casting methods. Spray forming is currently at the development stage in the United States and Europe, and has been commercialized to a limited extent in Japan.

[39] Developed by SMS Schloemann-Siemag AG, Germany.

[40] Developed by Mannesmann Demag AG, Germany and The Arvedi Group, Italy.

[41] Jo Isenberg-O'Loughlin, "Nearer to Net," *33 Metal Producing*, Jan. 1993, pp. 18-22, 47.

[42] The commercial-scale facility is casting stainless, not carbon steel. If successful, the technology is expected to be transferable to the casting of carbon steel.

Environmental Regulation[43]

Over the past decade, environmental regulations have expanded to encompass practically every stage of the steelmaking process. Environmental regulations have affected industry costs, investment, operations, and R&D. The cost of operating and maintaining equipment associated primarily with environmental control is estimated to be between $10 and $20 per ton of steel shipped.[44] During 1992, capital expenditures on environmental pollution control totalled $287 million for carbon and certain alloy steel producers and $10 million for stainless and alloy tool steel producers.[45] Such expenditures accounted for 11 and 8 percent, respectively, of total capital expenditures of carbon and certain alloy steel and stainless and alloy tool steel producers that year.

Steelmaking produces many air pollutants, including carbon monoxide, nitrogen oxides, sulfur dioxide, and particulates. Airborne pollutants from the coke,[46] iron, and steelmaking processes have been associated with health problems in surrounding populations. As a result, concerns about airborne emissions have dominated regulatory interest in the industry. The most important air quality legislation that affects the steel industry is the Clean Air Act and its 1990 amendments (CAAA). Provisions covering air toxics, permits, and enforcement will also significantly affect the industry.

Title III of the CAAA establishes a two-step process to regulate toxic air emissions. The essence of this process requires the Environmental Protection Agency (EPA) to develop a list of source categories for each of 189 chemicals, including coke oven emissions, and then develop technology-based standards. Second, EPA must assess the risk remaining after imposition of technology-based standards and propose standards to reduce unacceptable risk levels. Until these risk-based standards are known, the full cost of compliance with the CAAA will remain uncertain.

Under the CAAA, coke oven emissions are targeted for early control. The remaining 188 air toxics listed in the amendments include compounds of chromium, nickel, manganese, cadmium, lead, and other heavy metals found in iron ore, steel scrap, and alloying materials. This comprehensive coverage, combined with the emission threshold that triggers

[43] Information in this section is largely drawn from U.S. International Trade Commission, *Steel Semiannual Monitoring Report*, investigation No. 332-327, publication 2682, Sept. 1993, pp. 13-19.

[44] Bruce A. Steiner, Vice President, Environment and Energy, American Iron and Steel Institute (AISI).

[45] For further information, see U.S. International Trade Commission, *Steel Semiannual Monitoring Report*, investigation No. 332-327, USITC publication 2655, p. 25, June 1993.

[46] The Commission is currently examining the effects of environmental regulations on coke producers and consumers in greater detail in a forthcoming study, *Metallurgical Coke: Baseline Analysis of the U.S. Industry and Imports*, investigation No. 332-342, instituted May 21, 1993, which will be released in Spring 1994.

permit requirements (10 tpy for any listed air toxic or 25 tpy for aggregate emissions), means that virtually all steel mills will be affected.

The steel industry is a major water user; production of a ton of steel requires an estimated 75,000 gallons of water.[47] Although much of this water is recycled in the steelmaking process, the industry is likely to be substantially affected by the higher threshold for water-quality standards at the Federal, State, and regional levels. The federal Clean Water Act imposes stringent requirements on the industry that are magnified by State regulations, which either equal or exceed those at the Federal level. Local concerns about water quality often have resulted in State requirements that are more restrictive than those at the national level.

State concerns about water pollutants have encouraged current efforts to develop uniform water-quality standards in the Great Lakes States, which contain about 80 percent of U.S. integrated steelmaking capacity. State efforts to achieve higher water quality in all bodies of water in the Great Lakes basin may lead to increased operating costs, restrictions on increases in capacity, and zero discharge requirements. Such requirements may raise production costs, affecting the ability of firms to compete in already narrow-margin product lines in both U.S. and foreign markets.

Under the Resource Conservation and Reclamation Act (RCRA), the steel industry will continue to face many regulatory and legislative initiatives concerning control of solid and hazardous waste. RCRA is up for reauthorization, and issues of interest to the steel industry include processing and recycling of secondary materials, packaging restrictions, interstate waste transport, toxic use reduction, and environmental taxes. Such provisions significantly affect EAF steelmakers, since EAF dust is classified as hazardous waste.

Consumer Characteristics and Factors Affecting Demand

Although overall demand for semifinished steel directly depends on demand for finished steel products, the demand for merchant semifinished steel — i.e., semifinished steel that is sold on the open market — is affected by distinct factors. Regardless of the overall level of steel demand, if each steelmaker produced just enough semifinished steel to meet its own needs, there would be no demand for merchant semifinished steel except for that from the relatively small number of steel processors that purchase semifinished steel. Thus, the market for semifinished steel products stems from an imbalance between the industry's steelmaking capacity and its rolling capacity.

Firms that can produce crude steel more quickly than they can roll it may sell semifinished steel products in order to maintain a high melt shop operating rate. Alternatively, firms that have greater rolling than melting capacity may choose to buy semifinished steel in order to maintain a high operating rate at the rolling mills.

In 1992, the U.S. aggregate steelmaking capacity was 6 percent above steel rolling capacity. As shown in table 2, steel-producing companies (integrated, minimill, and specialty) had a surplus annual steelmaking capacity of 10.5 million tons, while steel processors had the capacity to roll 4.3 million tons of steel per year. Thus steel processors are an important outlet for excess semifinished steel produced by steel producers.

Even if firms have the capacity to produce the volume of semifinished steel needed to maintain high operating rates at the rolling mills, other considerations may favor the outside purchase of semifinished steel. Certain steel applications have very demanding requirements in terms of metallurgical characteristics, chemical composition, and shape/dimension. Steel producers that cannot meet the stringent specifications with their own semifinished steel often use semifinished steel purchased from a domestic or foreign steel producer. For example, imports of semifinished steel (excluding stainless) grew by 16 percent from 1991 to 1992, reportedly in anticipation of shortages of domestically produced semifinished steel.[48]

In general, semifinished steel from different sources is highly fungible, and certainly more fungible than other steel products. As steel is processed into finished products, steelmakers have more opportunity for product differentiation. For example, for flat-rolled products, steelmakers can differentiate their products through a special surface finish or surface flatness. Neither of those qualities is as important for semifinished steel. What is most important is the steel's chemistry (i.e., whether the semifinished product contains very low levels of contaminants or has certain desired elements). Semifinished steel can also be differentiated by unusual dimensional characteristics.

FOREIGN INDUSTRY PROFILE

Few steel-producing nations are actively involved in the production of semifinished steel for export. As with the U.S. steel industry, most foreign steel industries consume almost all of the semifinished steel that they produce. The major exception to this is Brazil, but newer entrants into the market may have a significant impact in the future.

Brazil's Companhia Siderurgica de Tuberão (CST) was built specifically for the production and export of semifinished steel products. Its capacity of 3.4 million tpy capacity[49] is large enough to produce and export eight times more semifinished steel than all of U.S.

[47] Telephone interview with official of American Iron and Steel Institute, June 1992.

[48] Release of the American Institute for International Steel, Inc., March 18, 1993.

[49] Iron and Steel Works of the World, 10th ed. (Surrey, England: Metal Bulletin Books, 1991), p. 47.

Table 2
Carbon and certain alloy steel:[1] U.S. steel melt capacity,[2] first-stage rolling capacity,[3] 1992.

(1,000 tons)

Sector	Melt capacity	First stage rolling capacity	Surplus melt capacity	Surplus rolling capacity
Integrated	79.6	72.3	7.3	0.0
Minimill	34.4	31.6	2.9	0.0
Processor	0.0	4.3	([4])	4.3
Specialty	2.6	2.3	0.3	0.0
Total	116.7	110.4	10.5	4.3

[1] Excludes stainless steel.

[2] Includes capacity of basic oxygen furnaces, electric arc furnaces and open hearth furnaces.

[3] First-stage rolling capacity includes the capacity of the following facilities: hot strip mills, plate mills, hot-finished bar mills, medium and heavy structural mills, seamless pipe mills, other (non-welded) pipe mills, rail and rail product mills, and wire rod mills.

[4] Not applicable.

Note.—Because of rounding, figures may not add to the totals shown.

Source: Information developed in connection with U.S. International Trade Commission, *Steel Semiannual Monitoring Report*, investigation No. 332-327, USITC publication 2655, June 1993.

semifinished exports combined. The availability of high-grade iron ore and low-cost labor gives Brazil's steel producers a considerable competitive advantage in primary stage operations.

The significance of Brazil's position in the global semifinished market is illustrated in figure 4, which shows that Brazil accounted for slightly more than one-third of world semifinished steel exports in 1992. Brazil's largest export market is the United States, to which it directed 19 percent of its semifinished steel exports in 1992.[50] Other major markets for Brazilian semifinished steel are countries with emerging steel industries: Korea, Taiwan, Turkey, and the Philippines.

In addition to Brazil, steel-producing nations in Europe are active in the world semifinished export market. The United Kingdom, Germany, and France accounted for 27 percent of the world export market in 1992. Unlike the case of Brazilian exports, most of these exports (64 percent in 1992) are shipped to other countries within the European Union (formerly known as European Community), whereas only 16 percent were exported to the United States; a significant portion of those were exports from British Steel to Tuscaloosa Steel in Tuscaloosa, AL. In general, semifinished exports from European countries include higher value steels for more exacting applications, whereas Brazilian semifinished steel for export tends to be a commodity grade of steel.

Another country important in the world semifinished market is Mexico. Although its exports in 1991 accounted for only 2 percent of world exports, that share is likely to increase. The recently privatized Sibalsa facility in Mexico (formerly Sicartsa II) is believed to have exported all its 750,000 tons of slab production to the United States in 1990. The new owners of the 3-million tpy facility, which began operation in 1989, reportedly plan to boost slab exports to 2.5 million tons by 1994.[51] In 1990 and 1991, 100 percent and 94 percent of Mexico's semifinished exports were shipped to the United States.[52]

More recent entrants in the global semifinished steel market are steel producers from central and eastern Europe. Although data on exports from these countries are not available, the offering price for the semifinished exports is reportedly well below the offering price from traditional semifinished exporters; however, the quality is also reported to be substantially lower.[53]

U.S. TRADE MEASURES

Tariff Measures

The general tariff on semifinished steel applied by the United States is relatively low. As of January 1, 1993, the ad valorem tariff was 4.2 percent for carbon semifinished and 5.1 percent for other alloy semifinished (table 3). Several special tariff rates are also in effect. Under the Caribbean Basin Economic Recovery Act (CBERA), the U.S.-Israel Free Trade Agreement, and the Andean Trade Preference Act (ATPA), all semifinished steel imports for participating

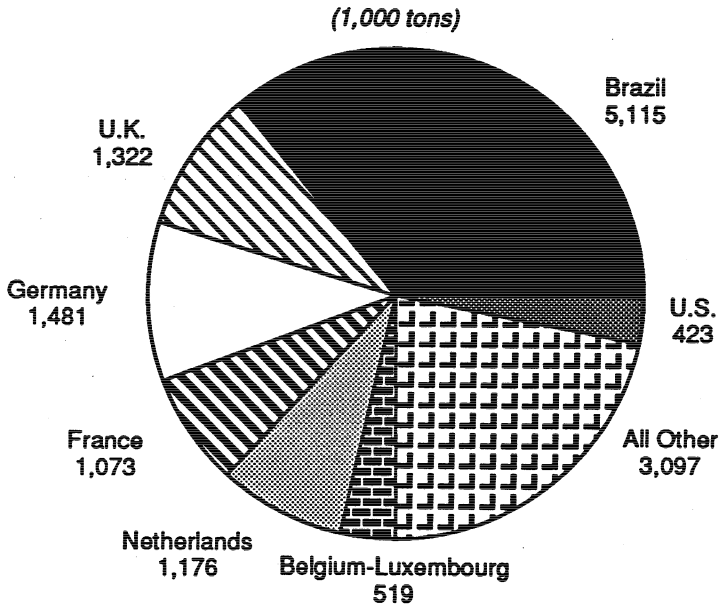
[50] United Kingdom Iron and Steel Statistics Bureau, *World Trade Steel*, 1992.

[51] Iron and Steel Works of the World, p. 304. "Ispat To Boost Mexico Slab Exports," Metal Bulletin, Nov. 17, 1991, p. 17.

[52] Mexican steel industry executive, telephone conversation with USITC staff to gather background information on the semifinished steel industry, June 18, 1992.

[53] Steel industry executives, interviews with USITC staff, Mar. 12-13, 1992.

Figure 4
Semifinished steel: World exports, by country, 1992



Note.—Figures represent reporting countries only. Notable omissions include countries of Central & Eastern Europe.

Source: U.K. Iron and Steel Statistics Bureau.

CBERA countries, ATPA countries, and Israel enter free of duty. Under the United States-Canada Free Trade Agreement (CFTA), tariff rates were 2.1 percent and 2.5 percent for carbon and alloy semifinished, respectively. U.S. tariffs on imports from Canada are being reduced gradually under the CFTA and will be totally eliminated on January 1, 1998. The Generalized System of Preferences does not include semifinished steel, with the exception of iron and non-alloy primary forms, other than ingots.

The NAFTA, as implemented by the North American Free Trade Agreement Implementation Act (Public Law 103-182, approved Dec. 8, 1993), provides for the phaseout of U.S. duties over a 6-year period. Mexico is obligated to phase out its duties on imports of such goods from the United States over a 10-year period. The NAFTA became effective for both the United States and Mexico on January 1, 1994.

The recently completed (December 1993) GATT Uruguay Round of trade negotiations may result in further reductions in U.S. and foreign duties on articles covered by this summary. The Uruguay Round Schedule of U.S. concessions was not available when this summary was prepared.

There is a proposal as part of the ongoing negotiations for a Multilateral Steel Agreement (MSA) to eliminate tariffs on most steel products over a 10-year period for the United States and 34 other countries. The MSA was not concluded in time for inclusion in the General Agreement on Tariffs and Trade (GATT) Uruguay Round of trade negotiations. However, the MSA tariff package was offered in the Uruguay Round by many MSA participants.

Nontariff Measures

Voluntary Restraint Agreements

Background

Between October 1, 1984, and March 31, 1992, semifinished steel products were covered under the program of voluntary restraint agreements (VRAs) with nine countries and the European Union. Although there were VRAs with several other countries, none included specific ceiling levels for semifinished steel.

The VRAs were instituted at the direction of the President in September 1984.[54] The decision followed an investigation conducted by the Commission under

[54] The President determined that the provision of relief under the Trade Act of 1974 was not in the national economic interest. See 49 *Federal Register* 36813 (Sept. 20, 1984).

Table 3
Semifinished steel: Harmonized Tariff Schedule subheading; description; U.S. col. 1 rate of duty as of Jan. 1, 1993; U.S. exports, 1992, U.S. imports, 1992

HTS subheading	Description	Col. 1 rate of duty as of Jan. 1, 1993		U.S. exports, 1992	U.S. imports, 1992
		General	Special[1]		
				Million dollars	
7206.10.00	Ingots of iron and non-alloy steel	4.2%	Free (E,IL,J) 2.1% (CA)	5	(2)
7207.11.00	Semifinished products containing by weight less than 0.25 percent of carbon, of rectangular (including square) cross section, the width measuring less than twice the thickness	4.2%	Free (E,IL,J) 2.1% (CA)	16	64
7207.12.00	Semifinished products containing by weight less than 0.25 percent of carbon, of rectangular (other than square) cross section, the width measuring at least twice the thickness	4.2%	Free (E,IL,J) 2.1% (CA)	6	348
7207.19.00	Other semifinished products containing by weight less than 0.25 percent of carbon, of circular cross section	4.2%	Free (E,IL,J) 2.1% (CA)	21	16
7207.20.00	Semifinished products containing by weight 0.25 percent or more	4.2%	Free (E,IL,J) 2.1% (CA)	50	43
7224.10.00	Ingots or other primary forms of alloy steel, not stainless steel	5.1%	Free (E,IL,J) 2.5% (CA)	13	31
7224.90.00	Semifinished products of alloy steel, not stainless steel	5.1%	Free (E,IL,J) 2.5% (CA)	40	428

[1] Programs under which special tariff treatment may be provided, and the corresponding symbols for such programs as they are indicated in the "Special" subcolumn, are as follows: United States-Canada Free-Trade Agreement (CA); Caribbean Basin Economic Recovery Act (E); United States-Israel Free Trade Area (IL); and Andean Trade Preference Act (J).

[2] Less than $500,000.

[3] Includes only 7224.10.0005 and 7224.10.0075, not 7224.10.0045, which covers tool steel ingots and other primary forms.

[4] Includes only 7224.90.0005, 7224.90.0045, 7224.90.0055, 7224.90.0065, 7224.90.0075. Other eight digit subheadings cover tool steel semifinished shapes.

Source: U.S. exports and imports compiled from official statistics of the U.S. Department of Commerce.

Section 201 of the Trade Act of 1974 (19 U.S.C. 2251) in which the Commission found that increased imports of certain carbon and alloy steel products were a substantial cause of serious injury, or threat thereof, to certain domestic industries and recommended to the President that he provide import relief in the form of tariffs and quotas (investigation No. TA-201-51).[55]

Instead of taking action under the Trade Act of 1974, the President established a nine-point policy to address the concerns of the industry in conjunction with authority under the Steel Import Stabilization Act of 1984 (title VIII of the Trade and Tariff Act of 1984) - (19 U.S.C. 2253). Under this policy, the President directed the United States Trade Representative to negotiate VRAs to cover a 5-year period (from October 1, 1984 through September 30, 1989) with countries whose exports to the United States had increased significantly in previous years due to an unfair surge in imports. Although the structure of the arrangements varied from one country to another, each involved an agreement by the foreign government to limit exports to the United States of certain steel products (including semifinished steel for some agreements). In return, U.S. producers withdrew pending unfair trade petitions and the U.S. Government suspended antidumping and countervailing duties that were in effect on steel products covered by the VRAs.

The trade measures were expected to return the share of overall steel imports (excluding semifinished steel) in the U.S. market to a more normal level of approximately 18.5 percent. The limits for semifinished steel were established separately in terms of a fixed tonnage set at 1.8 million tpy.[56]

On July 25, 1989, the President, with the approval of Congress under the Steel Trade Liberalization Program Implementation Act, extended the VRAs for 2-1/2 years, terminating on March 31, 1992. The VRAs were negotiated at an overall restraint level of 19.1 percent of the U.S. market and product coverage remained essentially unchanged, though the agreements were modified to include those specialty steel products that were previously subject to relief under section 203 of the Trade Act of 1974. Unlike the original VRAs, however, the renewed VRAs established market share—not fixed tonnage—ceilings for semifinished steel.

Impact of the VRAs

In the earlier years of the VRA program, many agreement countries reached or came close to reaching their ceiling levels for semifinished steel (table 4). In many cases, ceilings for semifinished steel were adjusted upwards to accommodate domestic requirements. The U.S. Department of Commerce could, upon agreement with the foreign government, transfer tonnages from one category to another or from one time period to another. For example, as noted in table 4, the 1988 export ceiling for Mexico increased from 100,000 tons to 134,244 tons. Despite the increase, however, exports of semifinished from Mexico did not reach even the unadjusted export ceiling and only filled 46 percent of the adjusted export ceiling. Thus, in some cases adjustments were made based on expectations that were not realized.

However, during 1986-88, many U.S. companies that relied on merchant semifinished steel found it difficult to obtain the steel they needed to meet their requirements. Because of a 1986 strike at USX, several companies filed "short supply" requests with the U.S. Department of Commerce to request additional tons of semifinished imports in excess of the VRA ceilings, but the requests were denied as USX resolved its labor dispute in early 1987. Shortages again appeared during 1987-88, when an increase in steel demand made it difficult for domestic steelmakers to meet demand for semifinished steel.

Several companies[57] again filed short supply requests. Under the VRAs, Commerce could increase the ceiling by 10 percent if it determined that semifinished steel was not available in sufficient quantities. Under extraordinary circumstances, it could increase the ceiling by an even greater amount. During 1987-89, Commerce granted 20 short supply requests for semifinished steel (some under the "extraordinary circumstances" provision), totaling 1.6 million tons. In the renewed VRA period, only 6 short supply requests were accepted, totaling 410,000 tons.[58]

After 1988, fewer agreement countries approached their ceilings. This was the case not only for semifinished steel, but for most steel mill products. The main reason for an underutilization of the export ceilings was that the United States market had become unattractive for foreign producers. As the value of the dollar declined relative to major foreign currencies, the cost to the U.S. steel consumer of foreign steel became relatively more expensive. Furthermore, as steel demand weakened in 1991, prices in the United States were low relative to steel prices in foreign markets. As a result, foreign producers directed their exports to those markets, particularly Pacific Rim countries in Asia, where they could obtain the highest return. And, over the course of the VRAs, the U.S. industry modernized and rationalized its facilities in a manner that substantially improved its international competitive position.

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[55] Affirmative decisions were rendered in the case of semifinished steel, plates, sheets and strip, wire and wire products, and structural shapes and units. Negative determinations were rendered in the case of wire rod, railway type products, bars, and pipes and tubes.

[56] This ceiling does not include the special allotment for semifinished imports granted to British Steel, which supplied Tuscaloosa Steel with slabs. During the renewed VRA period, the allotment increased from 200,000 tons per year to 250,000 tons per year.

[57] Companies that filed short supply requests included American Steel and Wire Corp.; CSI Corp.; Gulf States Steel, Inc.; Lone Star Steel Co.; Lukens Steel Co.; National Steel Corp.; Rouge Steel Co.; Tuscaloosa Steel Corp.; and USS-Posco Industries.

[58] U.S. Department of Commerce, Office of Agreements Compliance.

Table 4
Semifinished steel: Initial ceiling levels on exports from VRA countries to the United States, adjusted ceilings, and fill ratio, Jan. 1986-Mar. 1992[1]

Country/ region	1986	1987	1988	Jan.-Sept. 1989	Oct. 89-Dec. 90[2]	Jan. 1991-Mar. 1992[2]
	Initial export ceiling *(1,000 tons)*					
Australia	50.0	50.0	50.0	37.5	141.5	198.0
Brazil	700.0	700.0	700.0	525.0	1,095.6	1,160.5
EU[3]	600.0	820.0	840.0	502.5	911.0	834.4
Finland	15.0	15.0	15.0	11.2	19.2	17.6
Japan	100.0	100.0	105.0	75.0	105.5	96.6
Korea	50.0	50.0	50.0	37.5	324.9	297.5
Mexico	100.0	100.0	100.0	75.0	287.7	296.4
Spain	50.0	50.0	50.0	(4)	(4)	(4)
Trinidad and Tobago	(5)	(6)	(6)	2.6	26.7	5.5
Venezuela	60.0	60.0	60.0	30.0	82.7	75.8
	Adjusted export ceiling[7] *(1,000 tons)*					
Australia	50.0	51.7	47.4	33.5	167.9	204.6
Brazil	706.6	719.2	616.2	525.0	1,114.4	1,176.5
EU	600.0	645.7	638.3	553.6	902.9	749.3
Finland	15.0	15.0	16.1	11.2	27.4	27.5
Japan	68.4	105.5	127.5	65.1	105.5	104.9
Korea	50.0	27.2	50.0	40.0	122.9	302.3
Mexico	100.0	125.2	134.2	148.0	287.7	302.4
Spain	50.0	54.0	54.3	(4)	(4)	(4)
Trinidad and Tobago	(5)	3.9	3.1	2.6	24.3	5.5
Venezuela	41.4	97.0	71.2	(6)	(6)	80.0
	Percent of adjusted ceiling filled					
Australia	96.68	104.96	108.43	84.59	90.58	96.90
Brazil	97.87	111.65	100.00	93.23	95.05	(6)
EU	98.53	100.25	90.25	67.59	62.16	66.88
Finland	99.35	92.98	20.18	97.86	87.10	97.99
Japan	85.24	87.66	82.02	63.40	14.20	5.25
Korea	99.98	99.95	83.57	82.05	0.11	7.17
Mexico	74.75	53.33	45.65	52.21	99.38	63.00
Spain	83.45	79.00	49.73	(4)	(4)	(4)
Trinidad and Tobago	(5)	110.42	98.83	100.00	0.00	(6)
Venezuela	54.07	88.43	65.40	(6)	(6)	49.00

[1] The VRAs expired in March 1992.

[2] In extension of VRAs, semifinished steel was limited by market share, not absolute volume. Figures represent tonnage equivalent of market share.

[3] Under the EU VRA, British Steel could export an additional 200,000 metric tpy of slab to Tuscaloosa Steel during the initial period, and 250,000 metric tpy under the renewed VRA.

[4] Covered under the VRA for the European Union.

[5] No VRA in effect during this time period.

[6] Not available.

[7] Adjustments of export ceilings among product categories were made at the discretion of the Department of Commerce.

Note.—Additional tonnages granted in response to short supply requests are not reflected in this table.

Source: U.S. Department of Commerce, Office of Agreements Compliance.

Multilateral Steel Agreement

As part of the Steel Trade Liberalization Program and the Bilateral Consensus Agreements negotiated under that umbrella, countries agreed to work towards a Multilateral Steel Agreement that would address the underlying causes of unfair trade in steel. The MSA would eliminate most tariffs, such nontariff measures as quotas, and most subsidies in the steel sector. The United States and 34 other countries have taken part in negotiations for an MSA under the general auspices of the GATT. Although the MSA was not concluded in time for inclusion in the GATT Uruguay Round of trade negotiations, the MSA tariff package, which calls for the elimination of steel tariffs over a 10-year period, is being offered in the Uruguay Round by many

MSA participants. General negotiations on the MSA are expected to resume in early 1994.

U.S. Government Trade-Related Investigations

Although steel products have been the subject of many countervailing and antidumping investigations, particularly in the early 1980s, semifinished steel has not, until recently, been included in any unfair trade case. In large part, this reflects the small level of semifinished steel imports relative to imports of other steel products.

The first investigation that included semifinished steel, based on a petition filed on June 9, 1992, covered certain special quality carbon and alloy hot-rolled bars and rods and semifinished products thereof from Brazil (investigation No. 731-TA-572 (Preliminary)). On July 21, 1992, the Commission made an affirmative preliminary determination, allowing the U.S. Department of Commerce to proceed with its investigation. Commerce subsequently made an affirmative preliminary and final determination of dumping. However, on July 9, 1993, the Commission made a negative final determination in the investigation.[59] Consequently, no antidumping order was issued.

Semifinished steel was included in the 1984 section 201 ("escape clause") investigation on carbon and certain alloy steel products (investigation No. TA-201-51). The Commission determined that semifinished steel was being imported into the United States in such increased quantities as to be a substantial cause of serious injury, or the threat thereof, to the domestic industry. Three of the five Commissioners recommended that additional duties be imposed on semifinished imports exceeding 1.5 million tpy. Two Commissioners recommended that no relief be provided. The President instituted the program of voluntary restraint agreements after the Commission's determination.

FOREIGN TRADE MEASURES

Tariff Measures

Foreign government tariffs on semifinished steel are low-to-average relative to those on other steel products. As seen in table 5, among the major trading partners of the United States, the country with the highest tariff rate is Brazil; Canada's tariffs are the lowest. Tariff rates have dropped considerably in the past few years in many developing countries. For example, in Mexico, the tariff on carbon semifinished steel has fallen from 25 percent to 10 percent, and in Brazil, the tariff rate fell from 37 percent to a range of 5-15 percent.

Further tariff reductions may be forthcoming. Nations involved in the MSA negotiations[60] under the Uruguay Round of GATT are considering a phase-out of steel tariffs over a 10-year period, provided the phaseout is part of a total package to eliminate most subsidies and nontariff barriers in steel, as well as tariffs.

Under the North American Free-Trade Agreement (NAFTA), tariffs for most steel mill products between the United States and Mexico are to be eliminated in equal stages over a 10-year period. Tariffs on steel trade between the United States and Canada would be phased out under NAFTA as previously agreed under the U.S.-Canada Free-Trade Agreement.

Nontariff Measures

Non-tariff measures imposed by foreign countries on U.S. exports of semifinished steel include import-licensing requirements, standards requirements, buy-national policies, and unfair trade (dumping) complaints. None of these appears to be a key factor affecting U.S. semifinished steel export levels. Furthermore, recent liberalization efforts in several countries have diminished existing barriers. For example, import-licensing requirements in Argentina have been abolished, and those in Brazil have been substantially weakened.[61]

Foreign government assistance to national steel industries also serves as a barrier to U.S. exports of steel, since it gives foreign producers a competitive advantage. Past levels of subsidization have been substantial and government ownership in the steel industry was not uncommon.[62] However, moves to privatize state industries, including steel, have fundamentally affected the global steel industry, as has the general decline in government assistance. This trend favors the U.S. industry in the long term, since it has in the past received only relatively small levels of direct assistance from the U.S. Government.[63]

U.S. MARKET

Consumption

In response not only to changes in the melting-rolling capacity gap (see Consumer

[59] For further information, see U.S. International Trade Commission, *Certain Special Quality Carbon and Alloy Hot-Rolled Steel Bars and Rods and Semifinished Products from Brazil*, investigation No. 731-TA-572(F), USITC publication 2662, July 1993.

[60] There are 35 countries involved in the MSA negotiations. Included are all the VRA countries (except the Peoples Republic of China) and the twelve member countries of the European Community, as well as Canada, Argentina, New Zealand, Norway, Sweden, Switzerland, Turkey, and the United States.

[61] U.S. International Trade Commission, *U.S. Market Access in Latin America: Recent Liberalization Measures and Remaining Barriers* (investigation No. 332-318), USITC publication 2521, June 1992, pp. 7-8 and 7-15.

[62] A more detailed discussion of government aid and assistance to major steel industries is contained in U.S. International Trade Commission, *Steel Industry Annual Report*, investigation No. 332-327, USITC publication 2436, September 1991, pp. 3-15 through 3-25.

[63] Ibid.

Table 5
Carbon and alloy semifinished steel: Ad valorem tariff rates applicable to U.S. exports in 1992, by country

(Percent)

Country/ region	Carbon			Alloy		
	Ingots	Slabs & sh. bars	Blooms billets	Ingots	Slabs & sh. bars	Blooms billets
EU	2.5	3.2	3.2-6.0	2.5	3.2	3.2-6.0
Canada[1]	0	2.4	2.4-6.1	0	2.4	2.4-6.1
Japan	4.3-5.8	4.3	4.3	5.8-8.2	5.8-8.2	5.8-8.2
Korea[2]	5	5	5	5	5	5
Brazil	5	10-15	10-15	35	35	35
Mexico	10	10	10	10	10	10

[1] Represent tariffs in fifth year of 10-year phase-out of import tariffs. Tariffs are scheduled to be eliminated as of January 1, 1998.

[2] Tariff rate is assessed on C.I.F. value of imported product. A value-added tax of 10 percent is assessed on the C.I.F. plus duty value.

Source: Official Journal of the European Communities; McGoldrick's Canadian Customs Tariff; Customs Tariff Schedules of Japan; Tariff Schedules of Korea; Tarifa Aduaneira do Brasil; and Ley del Impuesto General de Importación.

Characteristics and Factors Affecting Demand), but to market conditions as well, the market for semifinished steel fluctuated during 1988-92, falling to its lowest level in 1990, then rising by 10 percent to 4.2 million short tons in 1992 (table 6). Many steelmakers with excess rolling capacity could not melt enough steel to meet the needs of their customers in 1988 when steel demand was strong; consequently, they bought semifinished steel on the open market (domestic or foreign) to supplement the feedstock for their rolling mills. Consumption of merchant semifinished rose during the 1991 recession, as steelmakers tried to lower average production costs by maintaining high melt shop operating rates and selling surplus semifinished steel to domestic or foreign customers.

Reflecting the move of U.S. producers towards continuous casting and the increasing demands of customers for continuously cast steel, a decreasing percentage of merchant semifinished consumption is accounted for by ingots as opposed to semifinished shapes. In 1988, 11 percent of semifinished consumption was accounted for by ingot consumption. By 1992, only 3 percent was accounted for by ingot consumption.

Shipments

Slowly strengthening conditions in the steel market in recent years combined with an increasingly competitive U.S. steel industry led to an uneven increase of 20 percent in U.S. shipments of semifinished steel during the 1988-92 period. As seen in table 7, much of the increase came from shipments of carbon semifinished shapes.

The 19-percent overall increase in semifinished shipments between 1990 and 1992 seems to have reflected more the displacement of imports by domestically produced semifinished steel, rather than strong conditions in the steel market. Semifinished steel is a fungible commodity, (see Consumer Characteristics and Factors Affecting Demand) and suppliers to the market can change in response to changing market conditions. With steel prices in the United States at low levels in 1991 and 1992, some foreign producers may have decided to exit the market. Furthermore, as the U.S. industry invested in new equipment (such as continuous casters), it became more competitive, making it difficult for foreign producers to make a profit by selling in the United States. Despite the generally increasing trend in shipments of semifinished steel, shipments remained relatively small, representing just 3 percent of total shipments of steel mill products in 1992.

Imports

Much imported semifinished steel is consumed by a handful of steel companies that have long-term contracts with foreign steelmakers for semifinished steel. Imports fluctuated somewhat during 1988-92, with the largest tonnage growth occurring in 1992 in response to increasing steel demand (table 8). California Steel Industries Corp. (CSI), the Fontana, CA-based hot-rolled sheet producer, relies on imported slabs, primarily from Brazil, and, more recently, Mexico. Established in 1984, CSI is a joint venture between Kawasaki Steel of Japan and Companhia Vale do Rio Doce (CVRD), the Brazilian natural resources company. Tuscaloosa Steel, located in Tuscaloosa, Alabama, imports slabs from its owner, British Steel.

Import penetration in semifinished steel in the merchant market is high relative to levels for steel mill products in general, partly because of the internationalization of the market, as reflected by the trends in joint ventures. While imports accounted for 49-68 percent of the semifinished merchant market during 1988-92 (table 9), they accounted for 18-21

Table 6
Semifinished steel: U.S. apparent consumption, by kind and grade, 1988-92

(1,000 tons)

Item	1988	1989	1990	1991	1992
Carbon and alloy:					
Ingots	458.3	324.7	347.5	180.2	118.3
Shapes	3,846.2	3,498.7	3,422.2	3,867.7	4,047.4
Total	4,304.5	3,823.4	3,769.7	4,047.9	4,165.7
Carbon:					
Ingots	232.6	168.0	168.7	75.1	60.2
Shapes	3,375.7	3,151.5	3,041.0	3,487.8	3,620.6
Total	3,608.3	3,319.5	3,209.7	3,562.9	3,680.8
Alloy:					
Ingots	225.7	156.8	178.8	105.1	58.1
Shapes	470.6	347.2	381.2	379.9	426.7
Total	696.3	504.0	560.0	485.0	484.8

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

Table 7
Semifinished steel: U.S. shipments, 1988-92

Item	1988	1989	1990	1991	1992	Change 1988-92
	(1,000 tons)					*Percent*
Carbon and alloy:						
Ingots	375.0	342.0	331.2	234.2	184.3	-50.9
Shapes	1,476.2	1,643.8	1,542.4	2,234.9	2,041.7	38.3
Total	1,851.2	1,985.8	1,873.6	2,469.1	2,226.0	20.2
Carbon:						
Ingots	147.8	182.3	146.1	114.0	111.3	-24.7
Shapes	1,145.2	1,390.8	1,195.2	1,913.7	1,664.6	45.4
Total	1,293.0	1,573.1	1,341.3	2,027.7	1,775.9	37.3
Alloy:						
Ingots	227.2	159.7	185.1	120.2	73.0	-67.9
Shapes	331.0	253.0	347.2	321.2	377.1	13.9
Total	558.2	412.7	532.3	441.4	450.1	-19.4

Source: American Iron and Steel Institute.

percent for all steel mill products. The relatively high import penetration in semifinished steel reflects the small merchant market for semifinished steel, which is believed to account for less than 5 percent of the semifinished steel produced. If import penetration were calculated on the basis of total semifinished consumption (merchant and captive), the penetration figure would be closer to 3 percent,[64] which is low compared with the adjusted import penetration for most finished steel mill products.

[64] Estimated by USITC staff.

FOREIGN MARKETS

Foreign Market Profile

Even though U.S. exports of semifinished steel have increased substantially since 1988, they accounted for less than 3 percent of total world semifinished exports in 1992.[65] Because of the

[65] Data from the U.K. Iron and Steel Statistics Bureau indicates that 1992 U.S. exports of semifinished steel accounted for 3 percent of total exports of semifinished steel from reporting countries. As the total excluded exports from Mexico and central and eastern Europe, the actual percentage is believed to be considerably smaller.

Table 8
Carbon and alloy semifinished steel: U.S. imports for consumption, by principal sources, 1988-92

Source	1988	1989	1990	1991	1992
			Quantity *(1,000 tons)*		
Brazil	(1)	666.1	813.3	704.3	967.6
Germany	(1)	298.4	238.2	244.2	282.0
United Kingdom	(1)	355.6	288.8	212.5	223.3
Canada	(1)	82.8	188.9	82.4	177.4
Australia	(1)	66.6	129.6	160.9	149.9
Mexico	(1)	76.7	228.0	201.3	124.4
Belgium	(1)	32.4	88.3	60.7	97.3
Sweden	(1)	60.8	64.6	90.6	76.2
Netherlands	(1)	58.7	60.5	63.9	69.0
France	(1)	159.3	123.0	125.5	39.1
All other	(1)	272.0	70.6	50.0	100.7
Total	2,512.0	2,129.4	2,293.7	1,996.4	2,306.9
			Value *(1,000 dollars)*		
Brazil	(1)	166,245	179,106	200,618	199,583
Germany	(1)	87,124	62,785	57,478	69,391
United Kingdom	(1)	86,245	69,170	53,841	55,284
Canada	(1)	27,225	51,064	24,892	42,583
Australia	(1)	13,629	26,479	35,603	33,308
Mexico	(1)	19,607	50,462	45,781	23,866
Belgium	(1)	8,048	17,748	12,291	18,612
Sweden	(1)	15,249	13,109	19,125	14,847
Netherlands	(1)	16,074	15,033	13,584	13,191
France	(1)	39,589	29,553	29,573	8,791
All other	(1)	69,913	21,226	12,827	20,394
Total	609,729	548,947	535,734	505,612	499,850
			Unit value *(dollars per ton)*		
Brazil	(1)	249.58	220.23	284.84	206.27
Germany	(1)	291.98	263.62	235.39	246.04
United Kingdom	(1)	242.50	239.53	253.39	247.58
Canada	(1)	328.84	270.39	301.96	239.97
Australia	(1)	204.79	204.25	221.22	222.20
Mexico	(1)	255.67	221.29	227.39	191.88
Belgium	(1)	248.53	200.98	202.52	191.26
Sweden	(1)	250.72	202.96	211.10	194.91
Netherlands	(1)	273.70	248.48	212.71	191.05
France	(1)	248.55	240.33	235.57	224.93
All other	(1)	257.05	300.75	256.49	202.62
Average	242.75	257.80	233.57	253.04	216.68

[1] Country-level detail is provided only for years in which there are actual trade data under the *Harmonized Tariff Schedule of the United States* (HTS).

Note.—Because of rounding, figures may not add to the totals shown.

Source: Compiled from official statistics of the U.S. Department of Commerce.

fungibility of semifinished steel, the demand for U.S. semifinished steel exports is relatively elastic. Foreign steel producers can easily substitute U.S.-produced semifinished steel for semifinished steel produced in another country. In addition, there are a wide variety of alternative suppliers, particularly steel producers in Brazil, Mexico, Russia, and eastern Europe (see Foreign Industry Profile above).

U.S. Exports

U.S. exports of semifinished steel increased 197 percent from 1988 to 1992, reaching 383,000 tons in 1992 (table 10). Nevertheless, semifinished steel still accounted for a relatively small share (9 percent) of total 1992 U.S. steel exports.

The increase in semifinished steel exports can be attributed to three principal factors. First, adjustment and modernization in the U.S. steel industry allowed U.S. steel producers to become more globally competitive in terms of production costs and product quality. Second, the devaluation of the dollar against major foreign currencies after 1987 made U.S. semifinished steel relatively more attractive to foreign consumers. Finally, weak demand combined with

Table 9
Semifinished steel: U.S. import penetration, by kind and grade, 1988-92

(Percent)

Item	1988	1989	1990	1991	1992
Carbon and alloy:					
Ingots	22.5	6.5	18.6	1.4	3.9
Shapes	62.6	60.3	65.1	51.6	56.9
Total	68.4	55.7	60.8	49.3	55.4
Carbon:					
Ingots	43.5	6.6	33.7	0.4	0.1
Shapes	66.7	63.0	70.1	53.9	61.3
Total	65.2	60.1	68.2	52.8	60.3
Alloy:					
Ingots	0.9	5.4	4.4	2.1	8.0
Shapes	33.3	36.0	26.3	29.8	19.0
Total	22.8	26.5	19.3	23.8	17.7

Source: Compiled from statistics of the American Iron and Steel Institute.

increased competition from low-cost minimills made U.S. steel prices low by international standards. This encouraged U.S. producers to look to overseas markets for better prices and for increased sales in order to maintain higher operating rates (thereby reducing average costs).

Semifinished exports were shipped to a very large number of countries, with the volume shipped to any one country often varying widely from year to year. For example, Mexico was a relatively small market for U.S. semifinished steel exports until 1991, when it became the second largest market behind Canada, and 1992, when it became the largest market.

U.S. TRADE BALANCE

The United States ran a deficit in semifinished steel trade during the entire 1988-92 period (table 11). From 1988 to 1991, the deficit declined steadily, reflecting the growth in exports. In 1992, the trade balance worsened as exports declined and the deficit reached $349 million. Mexico was the only major country market with which the United States achieved a trade surplus in 1992, reflecting both increased exports to and reduced imports from Mexico.

Table 10
Semifinished steel: U.S. exports of domestic merchandise, by principal markets, 1988-92

Market	1988	1989	1990	1991	1992
			Quantity *(1,000 tons)*		
Mexico	(1)	6.5	12.7	55.5	163.5
Ecuador	(1)	0.1	39.2	11.9	58.7
Canada	(1)	13.7	89.4	64.6	29.9
Taiwan	(1)	61.6	0.3	29.9	23.6
Singapore	(1)	77.2	0.1	3.5	21.0
Hong Kong	(1)	0.1	0.1	2.2	16.8
Colombia	(1)	1.9	1.0	0.3	8.5
France	(1)	1.1	12.1	18.3	6.7
Bermuda	(1)	0.1	0.0	0.1	6.0
Indonesia	(1)	11.3	34.0	47.5	5.6
All other	(1)	118.2	209.0	184.3	43.0
Total	129.2	291.7	397.6	417.9	383.2
			Value *(1,000 dollars)*		
Mexico	(1)	7,354	13,138	35,613	54,824
Ecuador	(1)	14	9,337	2,288	11,019
Canada	(1)	13,179	26,300	24,620	16,776
Taiwan	(1)	17,623	602	6,868	5,869
Singapore	(1)	17,557	548	1,928	4,602
Hong Kong	(1)	50	26	754	3,900
Colombia	(1)	764	772	388	3,423
France	(1)	1,537	23,965	32,072	3,282
Bermuda	(1)	31	0	12	1,245
Indonesia	(1)	2,368	7,377	9,633	986
All other	(1)	57,984	86,708	74,314	44,077
Total	28,062	118,461	168,773	188,479	150,003
			Unit value *(per ton)*		
Mexico	(1)	1,124.23	1,035.26	642.20	335.22
Ecuador	(1)	400.00	238.28	192.77	187.60
Canada	(1)	961.55	294.30	380.98	560.86
Taiwan	(1)	285.86	1,777.59	229.86	249.02
Singapore	(1)	227.34	4,455.28	558.36	219.52
Hong Kong	(1)	2,941.18	3,714.29	338.72	231.51
Colombia	(1)	407.47	994.84	1,197.53	404.28
France	(1)	1,374.45	1,982.67	1,756.46	488.54
Bermuda	(1)	1,347.83	(2)	923.08	208.96
Indonesia	(1)	210.30	217.14	202.76	177.12
All other	(1)	398.53	520.88	684.44	1,026.14
Average	217.22	406.12	424.53	451.07	391.41

[1] Country-level detail is provided only for years in which there are actual trade data under the new Schedule B (based on the *Harmonized Tariff Schedule of the United States*).

[2] Not applicable.

Note.—Because of rounding, figures may not add to the totals shown.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 11
Semifinished steel: U.S. exports of domestic merchandise, imports for consumption, and merchandise trade balance, by selected countries and country groups, 1988-92[1]

(Million dollars)

Item	1988	1989	1990	1991	1992
U.S. exports of domestic merchandise:					
Brazil	(2)	5	3	2	(3)
Mexico	(2)	8	14	37	55
Germany	(2)	2	3	4	4
United Kingdom	(2)	8	7	7	5
Canada	(2)	14	26	25	17
Australia	(2)	2	(3)	9	1
Belgium	(2)	(3)	4	2	1
Sweden	(2)	(3)	(3)	1	(3)
Netherlands	(2)	(3)	1	1	1
France	(2)	2	24	32	3
All other	(2)	108	110	125	64
Total	52	149	192	245	151
EU-12	(2)	15	42	57	19
OPEC	(2)	3	17	14	12
ASEAN	(2)	21	14	16	7
CBERA	(2)	15	18	9	8
Eastern Europe	(2)	0	0	(3)	(3)
U.S. imports for consumption:					
Brazil	(2)	167	179	201	200
Mexico	(2)	20	53	46	24
Germany	(2)	88	63	58	69
United Kingdom	(2)	87	70	54	55
Canada	(2)	31	53	28	43
Australia	(2)	14	27	36	33
Belgium	(2)	8	18	12	19
Sweden	(2)	15	13	19	15
Netherlands	(2)	16	15	14	13
France	(2)	40	30	30	8
All other	(2)	71	20	12	21
Total	616	557	541	510	500
EU-12	(2)	245	210	168	165
OPEC	(2)	10	0	0	8
ASEAN	(2)	0	0	0	0
CBERA	(2)	0	0	0	0
Eastern Europe	(2)	(3)	(3)	(3)	0
U.S. merchandise trade balance:					
Brazil	(2)	-162	-176	-199	-200
Mexico	(2)	-12	-39	-9	31
Germany	(2)	-86	-60	-54	-65
United Kingdom	(2)	-79	-63	-47	-50
Canada	(2)	-17	-27	-3	-26
Australia	(2)	-12	-27	-27	-32
Belgium	(2)	-8	-14	-10	-18
Sweden	(2)	-15	-13	-18	-15
Netherlands	(2)	-16	-14	-13	-12
France	(2)	-38	-6	2	-4
All other	(2)	37	90	113	43
Total	-564	-408	-349	-265	-349
EU-12	(2)	-203	-168	-111	-146
OPEC	(2)	-7	17	14	4
ASEAN	(2)	21	14	16	7
CBERA	(2)	15	18	9	8
Eastern Europe	(2)	0	0	(3)	(3)

[1] Import values are based on customs value; export values are based on f.a.s. value, U.S. port of export. U.S. trade with East Germany is included in "Germany" but not "Eastern Europe."

[2] Country-level detail is provided only for years in which there are actual trade data under the *Harmonized Tariff Schedule of the United States* (HTS) and the new Schedule B (based on the HTS).

[3] Less than $500,000.

Note.—The countries shown are those with the largest total U.S. trade (U.S. imports plus exports) in these products.
Source: Compiled from official statistics of the U.S. Department of Commerce.

APPENDIX A
EXPLANATION OF TARIFF AND TRADE AGREEMENT TERMS

TARIFF AND TRADE AGREEMENT TERMS

The ***Harmonized Tariff Schedule of the United States*** (HTS) replaced the *Tariff Schedules of the United States* (TSUS) effective January 1, 1989. Chapters 1 through 97 are based upon the internationally adopted Harmonized Commodity Description and Coding System through the 6-digit level of product description, with additional U.S. product subdivisions at the 8-digit level. Chapters 98 and 99 contain special U.S. classification provisions and temporary rate provisions, respectively.

Rates of duty in the ***general*** subcolumn of HTS column 1 are most-favored-nation (MFN) rates; for the most part, they represent the final concession rate from the Tokyo Round of Multilateral Trade Negotiations. Column 1-general duty rates are applicable to imported goods from all countries except those enumerated in general note 3(b) to the HTS, whose products are dutied at the rates set forth in ***column 2***. Goods from Albania, Armenia, Belarus, Bulgaria, the People's Republic of China, the Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Mongolia, Poland, Russia, Slovakia, Turkmenistan, and the Ukraine are currently eligible for MFN treatment. Among articles dutiable at column 1-general rates, particular products of enumerated countries may be eligible for reduced rates of duty or for duty-free entry under one or more preferential tariff programs. Such tariff treatment is set forth in the ***special*** subcolumn of HTS column 1. Where eligibility for special tariff treatment is not claimed or established, goods are dutiable at column 1-general rates.

The ***Generalized System of Preferences*** (GSP) affords nonreciprocal tariff preferences to developing countries to aid their economic development and to diversify and expand their production and exports. The U.S. GSP, enacted in title V of the Trade Act of 1974 and renewed in the Trade and Tariff Act of 1984, applies to merchandise imported on or after January 1, 1976 and before July 4, 1993. Indicated by the symbol "A" or "A*" in the special subcolumn of column 1, the GSP provides duty-free entry to eligible articles the product of and imported directly from designated beneficiary developing countries, as set forth in general note 3(c)(ii) to the HTS.

The ***Caribbean Basin Economic Recovery Act*** (CBERA) affords nonreciprocal tariff preferences to developing countries in the Caribbean Basin area to aid their economic development and to diversify and expand their production and exports. The CBERA, enacted in title II of Public Law 98-67, implemented by Presidential Proclamation 5133 of November 30, 1983, and amended by the Customs and Trade Act of 1990, applies to merchandise entered, or withdrawn from warehouse for consumption, on or after January 1, 1984; this tariff preference program has no expiration date. Indicated by the symbol "E" or "E*" in the special subcolumn of column 1, the CBERA provides duty-free entry to eligible articles, and reduced-duty treatment to certain other articles, which are the product of and imported directly from designated countries, as set forth in general note 3(c)(v) to the HTS.

Preferential rates of duty in the special subcolumn of column 1 followed by the symbol "IL" are applicable to products of Israel under the ***United States-Israel Free Trade Area Implementation Act*** of 1985 (IFTA), as provided in general note 3(c)(vi) of the HTS. Where no rate of duty is provided for products of Israel in the special subcolumn for a particular provision, the rate of duty in the general subcolumn of column 1 applies.

Preferential rates of duty in the special subcolumn of column 1 followed by the symbol "CA" are applicable to eligible goods originating in the territory of Canada under the ***United States-Canada Free-Trade Agreement*** (CFTA), as provided in general note 3(c)(vii) to the HTS.

Preferential nonreciprocal duty-free or reduced-duty treatment in the special subcolumn of column 1 followed by the symbol "J" or "J*" in parentheses is afforded to eligible articles the product of designated beneficiary countries under the ***Andean Trade Preference Act*** (ATPA), enacted in title II of Public Law 102-182 and implemented by Presidential Proclamation 6455 of July 2, 1992 (effective July 22, 1992), as set forth in general note 3(c)(ix) to the HTS.

Other special tariff treatment applies to particular ***products of insular possessions*** (general note 3(a)(iv)), goods covered by the ***Automotive Products Trade Act*** (APTA) (general note 3(c)(iii)) and the ***Agreement on Trade in Civil Aircraft*** (ATCA) (general note 3(c)(iv)), and

articles imported from freely associated states (general note 3(c)(viii)).

The **General Agreement on Tariffs and Trade** (GATT) (61 Stat. (pt. 5) A58; 8 UST (pt. 2) 1786) is the multilateral agreement setting forth basic principles governing international trade among its 111 signatories. The GATT's main obligations relate to most-favored-nation treatment, the maintenance of scheduled concession rates of duty, and national (nondiscriminatory) treatment for imported products; the GATT also provides the legal framework for customs valuation standards, "escape clause" (emergency) actions, antidumping and countervailing duties, and other measures. Results of GATT-sponsored multilateral tariff negotiations are set forth by way of separate schedules of concessions for each participating contracting party, with the U.S. schedule designated as Schedule XX.

Officially known as "The Arrangement Regarding International Trade in Textiles," the ***Multifiber Arrangement*** (MFA) provides a framework for the negotiation of bilateral agreements between importing and producing countries, or for unilateral action by importing countries in the absence of an agreement. These bilateral agreements establish quantitative limits on imports of textiles and apparel, of cotton and other vegetable fibers, wool, man-made fibers and silk blends, in order to prevent market disruption in the importing countries—restrictions that would otherwise be a departure from GATT provisions. The United States has bilateral agreements with many supplying countries, including the four largest suppliers: China, Hong Kong, the Republic of Korea, and Taiwan.