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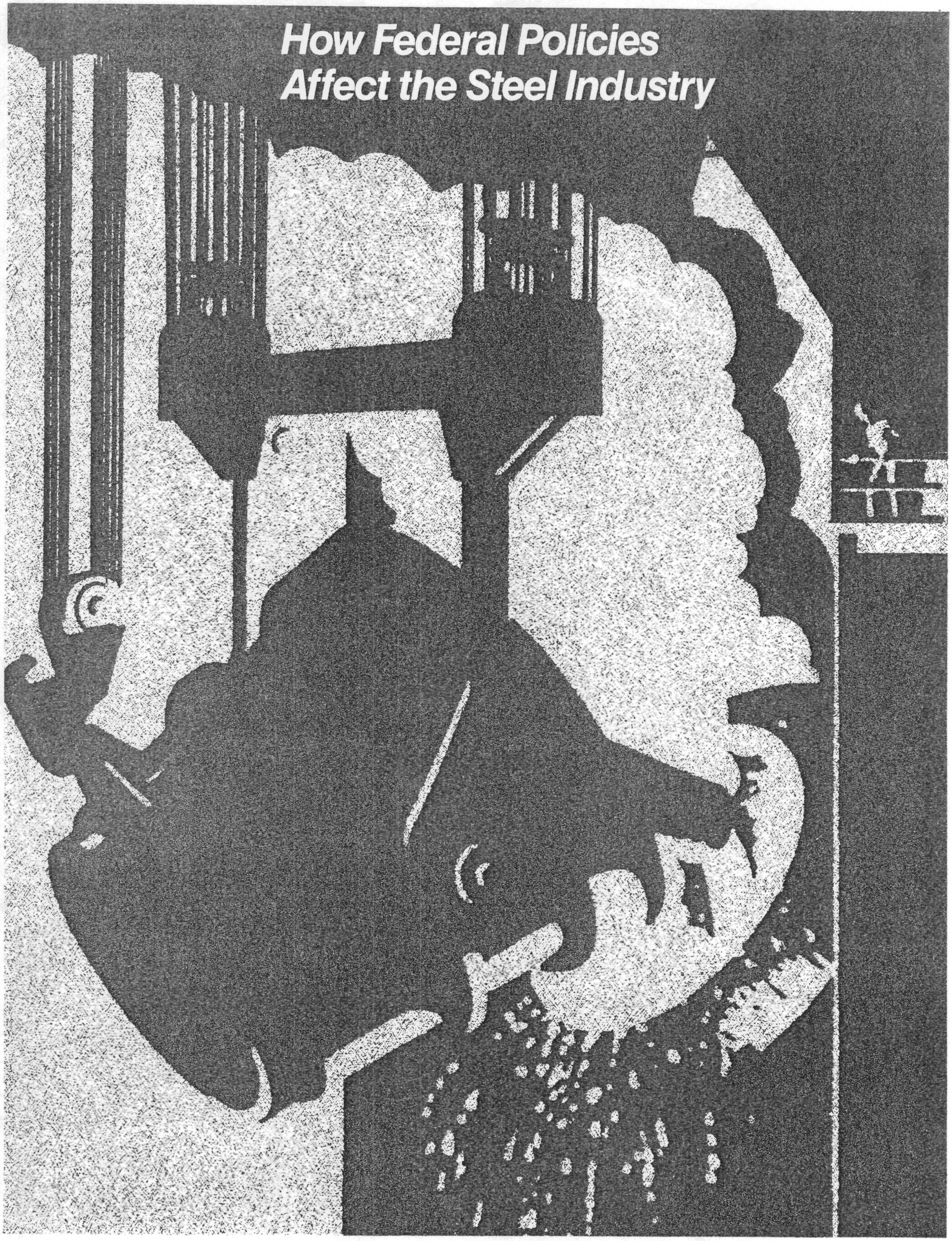
How Federal Policies Affect the Steel Industry



A SPECIAL STUDY

HOW FEDERAL POLICIES AFFECT THE STEEL INDUSTRY

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PREFACE

Actions of the federal government affect the steel industry through a variety of avenues. Among these are trade, tax, antitrust, research, and environmental policies. This paper examines how each of these policies affects the industry's ability to invest and compete. The report was requested by the Subcommittee on Investigations and Oversight of the House Committee on Science and Technology. In keeping with the mandate of the Congressional Budget Office (CBO) to provide objective analysis, no recommendations are made.

The report was prepared in CBO's Natural Resources and Commerce Division, under the supervision of Everett M. Ehrlich and Elliot Schwartz. Its several chapters and appendixes were written by Roger C. Dower, Everett M. Ehrlich, Daniel P. Kaplan, Thomas J. Lutton, Susan Punnett, Elliot Schwartz, and Philip C. Webre. The econometric simulations were performed by Andrew W. Horowitz under the direction of Thomas J. Lutton. Valuable comments on a preliminary draft were made by reviewers at the Department of Commerce and the Pension Benefits Guarantee Board, but responsibility for the finished product rests with CBO. The report was edited by Francis Pierce and prepared for publication by Kathryn Quattrone, assisted by Pat Joy.

Rudolph G. Penner
Director

February 1987

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SUMMARY

The integrated sector of the U.S. steel industry is in decline. Both output and employment in the industry have fallen significantly from the highs reached in the early 1970s. Some concern has been expressed as to whether capital formation in the sector is adequate to its needs, and whether policies of the federal government may have inhibited new investment. This paper reviews the federal policies affecting capital formation in steel. Those policies do not appear to have deterred investment in the steel industry, and in some cases--most notably, trade restraints--may have promoted it.

By and large, the problems facing the integrated sector of the steel industry (the sector with the largest producers) stem from causes unrelated to federal policy. Declining demand for steel products is probably the single largest factor. No steps the industry takes to improve its position can overcome this trend. Another of the industry's problems involves costs. Partly because of its own mistakes, and partly because of economic forces beyond its control, the integrated sector finds itself at a cost disadvantage relative to minimill producers (smaller-scale domestic steelmakers) and foreign steelmakers. Many analysts of the industry also point to an overhang of excess production capacity as inhibiting steel modernization. Firms may be hesitant to close their older facilities because of "shutdown" costs that often include expensive labor payments. In order to avoid these costs, they may sell steel at prices substantially below full cost when the market permits, discouraging investment in more modern facilities. Federal policy has had a negative effect on the steel industry insofar as fiscal policy has driven up the exchange rates of the dollar. But fiscal policy affects mainly the short-term prospects of the industry, and since the policy appears to be more stable now than it has been over the last decade, it should not be a major deterrent to capital formation generally, which increases the demand for steel. Indeed, forecasts of lower interest rates and exchange rates in coming years should encourage the demand for steel.

Although the steel industry is currently undergoing net disinvestment, it still adds an average of $2.5 billion each year to its gross stock of capital. Some analysts believe that the industry requires up to twice that amount to become competitive. Such calculations appear to be made on technological

rather than economic grounds, however. Current levels of capital formation in the industry reflect the low rate of return to such investments and appear to correspond well to investors' estimates of the industry's prospects. Using technological or other criteria as a guide to capital formation in the steel industry could draw resources away from more economically productive uses.

Moreover, higher levels of investment would probably do little to increase total sales and employment in steel. The primary sources of the industry's decline--most notably, falling steel consumption and the overhang of excess capacity--would be unaffected or even worsened by higher levels of investment. New investment in the industry also tends to be labor displacing and so would not improve employment prospects.

FEDERAL POLICIES

The federal government does not have a coordinated policy toward the steel industry, although a number of its programs and activities impinge on the industry. The government directly affects capital formation in steel through tax policy, research and development spending, import restraints, antitrust policy, and environmental regulations.

The tax rates paid by steel companies are about the same as those paid by the average manufacturing firm of equal profitability. This is particularly true now that the 1986 tax reform aims at greater neutrality among corporate taxpayers. But the new tax law even provides the industry with two exceptional benefits. First, the transition rules allow steel companies a refund on unused investment tax credits, which total $500 million for the 10 largest firms in the industry. These firms have been unable to use the tax credits because they have not been profitable enough to pay taxes. Second, as a permanent feature, the law permits the steel companies to use accumulated net operating losses (over $7 billion at present) to offset future income that would otherwise be taxable.

Federal agencies currently fund about $24 million a year in research that could aid innovation in the steel industry. Most of this research focuses on ways of making steel cheaper to produce, through savings on energy and materials and increased process control. The Department of Energy and Department of the Interior fund roughly $12 million in research on conserving steel inputs, while the National Science Foundation and the National Bureau of Standards spend $10 million on manufacturing process control. Federal R&D support, however, is small compared with the industry's own efforts.

Import restraints offer the steel industry a shield from foreign competition. But protective measures in the 1960s and 1970s did little to restore the industry's competitiveness, and the current voluntary restraints negotiated with foreign producers seem unlikely to be more effective. The CBO steel model suggests that the restraints will increase capital formation and employment only slightly, and at considerable expense to consumers who must pay higher prices for steel than they would otherwise. Moreover, the gains will be short-lived once restraints are removed.

Antitrust policy tends to prevent mergers and acquisitions that could allow more efficient use of existing capacity or an infusion of new capital or management expertise. This policy clearly operates at cross purposes with trade policy. While the government has imposed trade restraints that operate to raise the steel industry's cash flow by restricting supply and raising prices, antitrust policy tends to keep prices down by ensuring a diversity of producers.

Environmental regulations have imposed costs on all domestic industries. In the 1970s the steel industry spent 10 percent to 20 percent of its investment funds on pollution controls. The effects of this spending on the health of the industry are unclear. The CBO steel model suggests that the expenditures were not an important factor in the industry's performance.

POLICY IMPLICATIONS

The analysis in this report shows that the policies of the federal government have not inhibited steel industry investment. The current low level of investment in the industry is a symptom, not a cause, of its decline. This suggests that other approaches to the problems of the steel industry could be more effective than trying to stimulate investment.

One approach would emphasize research and development directed toward new technologies in steel production. Its rationale is that private incentives to increase R&D are limited, since private innovators never realize the full return on their innovations. Beyond this, the financial condition of the steel industry currently inhibits it from investing in research to increase productivity. The proposal is frequently made to establish joint public-private industrywide technology centers, similar to those envisioned by the Congress when it created Centers for Generic Technology in 1980. A drawback to this proposal is that a decade or more may be required to commercialize revolutionary steelmaking technologies. Moreover, the proposal raises management issues regarding the research agenda, dissemination conditions, and financing arrangements that are difficult to resolve.

Along with research and development, the government could take an active hand in restructuring the steel industry. Such a policy would seek to facilitate the closing of antiquated plants, encourage mergers, and assist in rationalizing the industry to serve a smaller market.

Finally, rather than intervening, the federal government could adopt a policy of assisting dislocated workers. Such assistance could include relocation and retraining. Such a program was available under the Trade Adjustment Assistance Act, but workers generally opted to receive income support instead of retraining, in the hope that their jobs would return. This problem may not recur in the steel industry. Opponents of such a policy note that workers elsewhere in the economy are displaced from their jobs for a variety of reasons, and that special treatment for one industry's labor force may be inequitable.

CHAPTER I

INTRODUCTION

The U.S. steel industry is in long-term decline. Some facts and figures quickly reveal the dimensions of the problem. Domestic steel production today is at less than 60 percent of its 1973 level. Steel consumption, after peaking at 122.5 million tons in 1973, has fallen steadily to about 90 million tons in 1986. This level is substantially higher than the 74.7 million tons consumed in the recession year of 1982, but consumption is not projected to increase much beyond today's levels. Employment in steel, which was over 600,000 in 1973, now stands at less than 200,000. Moreover, worldwide overcapacity in steelmaking constrains prices and depresses profits to negative levels. In 1985, imports accounted for 25 percent of U.S. steel consumption; steel product prices were falling; and after-tax losses in the U.S. industry were $1.25 billion.

STRUCTURE OF THE STEEL INDUSTRY

The U.S. steel industry includes three distinct sectors: integrated producers, specialty-steel producers, and minimills. 1/ The problems of the industry are most severe among **integrated producers**, which are the traditional core of the industry. These are typically multiplant firms with multiple operations. They own their own raw material properties, transportation networks, and sometimes even manufacturing plants that use steel. Integrated producers generally process steel through all its phases of production, from coke oven and blast furnace to rolling mills. Competition from foreign producers and from domestic minimills has reduced the market share of integrated firms from over 80 percent in 1950 to under 50 percent now.

Specialty steel producers typically begin with scrap steel, which they melt in electric furnaces to produce higher-valued, special-applications products such as alloy, stainless, and tool steels. These are gradually in-

1. For a fuller treatment of the industry's structure see Congressional Budget Office, *The Effects of Import Quotas on the Steel Industry* (July 1984).

creasing as a share of total U.S. steel output. This sector also includes the specialty steel operations of integrated firms, but most of the output comes from a large number of small, specialized producers whose product is distinctly different from nonspecialty or "carbon" steel.

Minimills also melt scrap in electric furnaces, but they produce carbon-grade steel that competes with the output of integrated producers. Minimills typically use a technologically advanced process known as continuous casting. Since 1960, minimills have increased their market share from about 3 percent to over 20 percent. 2/ They have proved to be profitable, technologically advanced, and competitive with foreign producers. Their output, however, tends to be restricted to less sophisticated products that do not compete with the full range of products offered by the integrated sector. 3/ The success of the minimill sector portends a restructuring of the industry into one that will be smaller, more fragmented, regionally focused, less unionized, and technologically more modern.

PROBLEMS FACING THE STEEL INDUSTRY

Economic forces have reduced the steel industry (particularly the integrated sector) from one of the most profitable U.S. industries, providing an engine of growth for the economy, to one of the least profitable. Some of the industry's difficulties are of its own making; others stem from forces beyond its control. Three factors that have contributed to the integrated sector's decline are: high costs and technological backwardness; the reduction in steel use in the U.S. economy; and general economic conditions, including high exchange rates. 4/

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2. See Donald F. Barnett and Robert W. Crandall, *Up From the Ashes* (Brookings Institution, 1986), p. 9.

3. Over time this may change. One of the leading minimill operators recently announced plans to build the first minimill capable of producing sheet steel from slab. See American Metal Market, "Nucor's Thin-Cast Sheet Facility To Be On-Stream in First Half of '89" (January 7, 1987), p. 1.

4. The analysis that follows draws in part on the CBO Steel Industry Model. This multi-equation model has been used to simulate steel industry performance under a variety of assumptions. References in the text to the CBO steel model refer to the results of these simulations. For more information on the model, see Appendix A.

High Costs

Foreign producers are able to make steel at lower cost than U.S. integrated producers, partly because of lower labor costs but also because they enjoy raw material and capital cost advantages. Estimates of the costs of producing steel in 1980 gave foreign producers a 17 percent to 30 percent price advantage, depending on the number of products measured and the scope of cost coverage. 5/ The recent devaluation of the dollar has improved the price competitiveness of the industry somewhat, but significant disadvantages remain.

Labor costs account for roughly 30 percent of the total cost of steel produced in the United States. In the 1950s, high labor costs were offset by high output per worker. But foreign productivity in steel now meets or exceeds U.S. levels, while U.S. hourly compensation (wages plus other benefits) remains relatively high. One measure of relative labor costs is the hourly compensation of steelworkers compared with that of all manufacturing workers. U.S. steelworkers received 97 percent more than the average manufacturing worker in 1982, and 63 percent more in 1984. In Japan, compensation for steelworkers was 73 percent higher than that of all workers in 1984, but Japanese steelworkers still earned 80 percent less than their American counterparts (at 1984 exchange rates). 6/

In raw materials, foreign producers also have cost advantages. U.S. producers have depleted the deposits of low-cost, high-quality iron ore that initially gave them a competitive advantage, and have been forced to turn to sources outside North America. Iron ore from these sources is expensive to transport to U.S. plants, which are not located near deep-water ocean ports. Iron ore represents roughly 15 percent of the total costs of

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5. See Congressional Budget Office, *The Effects of Import Quotas on the Steel Industry* (July 1984), p. 25. For the 1986-1989 period, the CBO steel model projects a price advantage for foreign producers of 15 percent to 20 percent. This is significantly less than the 40 percent differential that existed in 1984 (part of the difference being the result of lower exchange rates).

6. Figures are based on unpublished BLS data. In Canada, steelworker compensation was 35 percent greater than the all-manufacturing average; in Germany it was 10 percent. See Congressional Budget Office, *Has Trade Protection Revitalized Domestic Industries?* (November 1986), pp. 41-44.

producing steel. U.S. producers paid almost 50 percent more per ton than Japanese producers in 1984. 7/

Production facilities in the United States are older than many facilities elsewhere, and lack some productive improvements that have been incorporated in newer foreign plants. Only one new integrated steel plant has been built in the United States since the 1950s. U.S. producers have modified or retrofitted existing plants to incorporate innovations (such as basic oxygen furnaces) that have improved the efficiency of steel production, but many of the most significant innovations, such as continuous casting and automated process controls, have been less widely adopted. Basic oxygen furnaces accounted for 59.4 percent of U.S. crude steel production in 1985, compared with 70.7 percent of Japanese production. Similarly, about 40 percent of U.S. production is continuously cast, while in Japan the ratio is close to 90 percent. 8/ From an engineering perspective, U.S. producers could increase their efficiency by building new facilities (so-called greenfield plants) designed around these innovations, but the costs of doing so would be prohibitive. 9/

Some foreign governments give subsidies to their steel producers. These subsidies have not only financed construction of modern facilities, but have also been used to maintain operations and preserve jobs at inefficient mills. As a result, worldwide capacity and output are greater than they would otherwise be, and prices are lower. In an effort to end these subsidies by national governments, the European Community has established quotas on production and imposed import restraints. Nevertheless, some countries that belong to the EC continue to subsidize their industries. Even if foreign subsidies stopped, however, world overcapacity is so great that U.S. producers would still be under very heavy competitive pressure.

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7. See Congressional Budget Office, *The Effects of Import Quotas on the Steel Industry* (July 1984).

8. Both the basic oxygen process and continuous casting represent more productive technologies than traditional methods. The basic oxygen process is an improvement on the traditional Bessemer method of steelmaking that accelerates the refinement process and reduces fuel costs. Continuous casting involves pouring molten steel directly into finished shapes, thus simplifying the production process while raising yields, improving product quality, and reducing energy needs.

9. Barnett and Crandall estimate that high construction costs would prevent a new integrated steel plant from producing steel as cheaply as an existing efficient integrated plant. See *Up From the Ashes*, pp. 52-55.

Falling Steel Consumption

Steel consumption in the United States and other developed countries is falling, and this is as significant a fact in the steel industry's decline as the competitive constraints described above. As shown in Table 1, consumption of steel in the United States has grown at a very slow rate in the postwar period relative to consumption in other countries, although growth has now slowed in those countries as well. The decline in steel consumption stems from a variety of sources. First, the United States has already built most of its large, steel-intensive investments, such as in infrastructure (ports, railways, roads, and bridges). Second, technological progress has increased the competition from new materials such as plastics, and new uses are being found for such older materials as aluminum, concrete, ceramics, and even woven fabrics of composite materials such as are used in aircraft and automobiles. The switch to competing materials is a result partly of their superior performance characteristics and partly of their lower costs; since 1947, the average price of steel mill products has risen nearly twice as fast as that of all other materials.10/ Technology has also improved the performance of steel so that less steel is required for each application. Finally, the shifting of economic activity from manufacturing into services, which are relatively less steel-intensive, has also reduced the demand for steel products.

An opposite trend is occurring in newly industrializing countries such as Brazil, Korea, and Mexico, which are developing manufacturing industries and building their infrastructure. They have also acquired the technology necessary to build large-scale, efficient steel facilities.11/ Steel output in developing countries has doubled since 1973, and the increase in U.S. steel imports has come largely from that source.

Macroeconomic Conditions

Along with the specific problems described above, the steel industry has suffered from the changing mix of monetary and fiscal policy over the past

10. Department of Labor, Bureau of Labor Statistics, Producer Price Index for Steel Mill Products versus All Intermediate Materials Used in Manufacturing.

11. The construction of a steel plant is a labor-intensive process. Because of their lower labor costs, developing countries have an advantage in building steel plants. See Congressional Budget Office, *Has Trade Protection Revitalized Domestic Industries?* (November 1986), p. 45.

decade. The industry is especially sensitive to economic fluctuations and changing interest rates.

Steel is a pro-cyclical industry. As the economy goes through cyclical expansions and contractions, steel output rises and falls more than other economic activities (see Figure I). In 1982, for example, when overall economic output fell by 2.6 percent, steel consumption fell by 25.6 percent. As the economy recovered in 1983, growing by 3.5 percent, steel consumption grew by 6.3 percent. These wide swings make investment planning in the industry difficult; they also discourage capital improvements, and make management reluctant to retire outdated plants that may become profitable in boom years.

Steel is also highly sensitive to interest-rate movements, not only because these movements influence the business cycle but because the demand for steel is derived from the demand for products that use steel, such as automobiles, investment goods, and construction, which in turn are sensitive to interest rates. (The automobile, construction, and machinery industries account for over 60 percent of steel consumption.) High real interest rates, exacerbated by federal deficits, have discouraged investment during the 1980s by raising the cost of capital and at the same time making alternative uses of investment funds more attractive than additional investment in steelmaking.

TABLE 1. GROWTH IN APPARENT STEEL CONSUMPTION (Compound annual percentage rates, 1950-1984) [a]

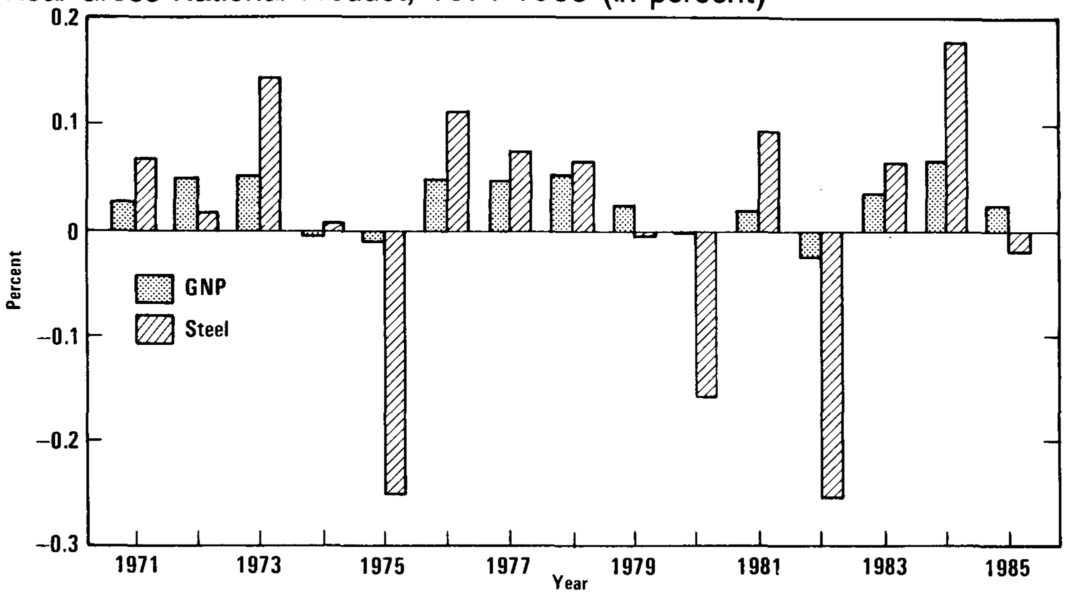
Period	U.S.	Japan	Canada	U.K.	EC [b]
1950-1981	1.0	9.8	3.1	0.3	3.6
1950-1960	0.4	17.3	2.5	3.3	8.3
1960-1969	4.3	13.1	6.8	2.5	5.6
1969-1984	-2.4	0.0	0.0	-3.6	-1.3

SOURCES: Federal Trade Commission, *Staff Report on the U.S. Steel Industry and Its International Rivals* (1977); International Iron and Steel Institute, *Statistical Yearbook* (various years).

a. Calculated from three-year averages on a basis of crude-steel equivalents.

b. Belgium, France, Italy, Luxembourg, the Netherlands, and West Germany.

Figure 1.
Annual Changes in U.S. Steel Consumption and in Real Gross National Product, 1971-1985 (In percent)



SOURCE: Congressional Budget Office.

Exchange rates derive from macroeconomic conditions, but represent a separate and painful problem for the steel industry. Rising exchange rates from 1980 through 1984 added a crippling blow to an already weakened industry. Estimates of the effect of the appreciating dollar on domestic industrial production conclude that primary metals (including steel) were the hardest hit of all--with production declining by roughly one-half of 1 percent for each 1 percent rise in the exchange value of the dollar.[12]

12. See Congressional Budget Office, "The Dollar in Foreign Exchange and U.S. Industrial Production" (December 1985) and William H. Branson and James P. Love, "Dollar Appreciation and Manufacturing Employment and Output," National Bureau of Economic Research, Working Paper No. 1972 (July 1986). Using somewhat different techniques and estimation procedures to calculate the impact of exchange rates on industrial production, these two papers reach similar conclusions. Branson and Love estimate that a 1 percent change in the exchange rate changes steel production by -0.54 percent; the CBO estimate was -0.48 percent. Estimates for primary metals were the highest obtained among all industries analyzed. Simulations using CBO's steel industry model yielded comparable results, an implied -0.51 percent change in domestic steel production stemming from a 1 percent rise in the exchange rate.

Although exchange rates have retreated from previous highs, they still remain about 30 percent above 1980 levels and cannot be counted on to provide much additional stimulus to the industry. This is particularly true because of the disparate trends in bilateral dollar exchange rates: the dollar has fallen dramatically against the Japanese yen, West German mark, and other currencies of the developed countries, but has not changed significantly or has even appreciated against the currencies of such developing-country steel producers as Korea, Mexico, and Brazil.

Future Prospects

There is no reason to believe that the fundamental trends described above will change, although the macroeconomic picture may brighten a bit. The minimill sector remains healthy, although technological constraints appear to limit its share of the steel market (a share sometimes estimated at 35 percent). In the rest of the steel industry, cost advantages clearly favor newer producers in the industrializing countries. The CBO model projects a decline in U.S. production costs as a result of lower factor costs and technological improvements. But by international standards, costs of production in the integrated sector will remain high. Even if technological breakthroughs in the United States were to overcome this cost advantage, the industry would still have to contend with declining steel consumption and with vigorous competition from other materials.

In the short term, the industry may benefit from more stable economic conditions than have prevailed in the recent past. The CBO forecast anticipates stronger overall investment and a declining exchange rate, both of which should improve the demand for steel products somewhat.

CAPITAL FORMATION IN STEEL

From one perspective the integrated sector's problems are related to a lack of capital formation. The integrated steel producers could become more competitive if they were to invest in new technology that would enhance productivity. Such investment does not come cheaply. The American Iron and Steel Institute states that adequate modernization would require investments of over $5 billion per year, a sum greatly exceeding the current annual average of about $2.5 billion.

A somewhat different perspective is suggested by two facts: first, that net capital formation in the integrated sector has been falling, as shipments and use of capacity have declined; and second, that falling profits imply that greater returns can be achieved through investment elsewhere.

The Decline in Net Capital Formation

As analyzed above, demand for steel products has been declining. Consequently, domestic steelmaking capacity far outstrips current needs, leading producers to cut capacity where possible in order to improve productivity. As shown in Table 2, annual steelmaking capacity remained roughly constant at about 155 million net tons from 1973 to 1982, then fell by about 13 percent from 1982 to 1985. But the production of crude steel dropped more than 40 percent during the same period, from 150.8 million net tons in 1973 to 87.6 million in 1985, meaning that use of capacity fell from 97.3 percent to 65.3 percent. (In the recession year of 1982, it hit a low of 48.4 percent.) The CBO steel model shows capacity continuing to fall slowly over the forecast period, with use of capacity first rising and then falling back to current levels.

These capacity reductions show that steel firms have responded to falling demand by disinvesting in steelmaking capacity--that is, by closing plants and writing off the assets from corporate balance sheets. Capacity reductions allow operating rates to increase, thus reducing production costs. Investment funds can then be concentrated at the most efficient plants, further improving the industry's competitive prospects. While such actions have severely negative effects on local communities, they are an effort to achieve the necessary end of reducing costs.

The Decline in Profitability

Financing capital improvements has been, and probably will continue to be, a problem for the integrated producers for two related reasons. First, internal sources of financing--that is, profits (and depreciation allowances) --have been nonexistent in recent years and are not likely to be significant in the near future. Second, external sources of financing, which also take their cue from profitability, have dried up because of the high risk and low potential return of investments in steelmaking capacity.

Since 1982, after-tax profits in the steel industry have given way to losses. The CBO steel model projects that the industry will show profits again in 1986-1989, partly on the assumption of lower exchange rates and higher steel prices. But the relative profitability of the industry is best measured in terms of the rate of return to capital. Compared with other industries, the rate of return to capital invested in steelmaking has been very low (see Table 3). Although after-tax profits achieved substantial levels during the 1970s, profits as a percent of stockholder equity were

TABLE 2. STEEL CAPACITY, PRODUCTION, AND OPERATING RATES

Year	Annual Capacity (millions of net tons)	Crude Steel Production (millions of net tons) a/	Use of Capacity (percent)
	Actual		
1973	155.0	150.8	97.3
1974	155.6	145.7	93.7
1975	153.1	116.6	76.2
1976	158.3	128.0	80.9
1977	160.0	125.3	78.4
1978	157.9	137.0	86.8
1979	155.3	136.3	87.8
1980	153.7	111.8	72.8
1981	154.3	120.8	78.3
1982	154.0	74.6	48.4
1983	150.6	84.6	56.2
1984	135.4	90.7	68.3
1985	134.1	87.6	65.3
	Projected		
1986	135.1	86.5	64.1
1987	130.8	90.5	69.2
1988	129.2	91.6	70.9
1989	128.8	90.5	70.3
1990	128.6	88.6	68.9
1991	128.4	86.4	67.3
1992	127.9	84.1	65.7

SOURCES: Historical data are based on the *Annual Statistical Report* of the American Iron and Steel Institute. Projections are based on the CBO steel model.

a. Crude steel production measures the raw steel output, from which finished steel products are made.

below the average for all manufacturing firms except in 1974. This relatively poor performance encourages investors to place their capital in more rewarding pursuits. Indeed, unless the marginal profitability of new steel investment is significantly higher than in alternative pursuits, the national welfare is enhanced if capital flows to those higher-valued uses.

The financial community has responded to the industry's declining financial condition by downgrading steel company bonds. As shown in Table 4, Moody's bond ratings for the top U.S. steel producers have declined significantly since 1982. The ratings are an indication of confidence in the companies' ability to repay, and as such are inversely related to a company's cost of borrowing--that is, interest rates on company-issued debt tend to be

TABLE 3. STEEL INDUSTRY PROFITS

	Before-Tax Profits (billions of current dollars)	After-Tax Profits (billions of current dollars)	After-Tax Profits as a Percent of Stockholder Equity	
			Steel	All Manufacturing
1970	0.993	0.692	4.3	9.2
1971	1.173	0.748	4.5	9.5
1972	1.650	1.022	6.0	10.3
1973	2.781	1.679	9.6	12.4
1974	5.384	3.151	16.1	14.4
1975	3.453	2.283	10.6	11.3
1976	2.895	2.086	8.9	13.6
1977	1.055	0.861	3.6	13.8
1978	3.470	2.122	8.8	14.5
1979	3.314	2.186	8.7	15.8
1980	3.325	2.405	8.9	15.2
1981	5.725	3.507	11.3	13.3
1982	-4.949	-3.705	-16.0	9.1
1983	-4.544	-3.746	-18.7	10.2
1984	0.117	-0.379	-2.7	12.2
1985	-0.811	-1.250	-10.2	10.0

SOURCE: Department of Commerce, *Quarterly Financial Review.*

NOTE: In 1973, reporting standards were changed to exclude foreign operations.

TABLE 4. MOODY'S BOND RATINGS OF SELECTED U.S. STEEL PRODUCERS, 1980-1986 a/ b/

Integrated	February 1980	As of January 1981	1982	1983	1984	1985	1986	June 1986
Armco	A	A	A	A2	Baa2	Baa3	Ba2	Ba2
Bethlehem	A	A	A	Baa2	Baa2	Ba1	Ba1	Ba2
Inland	Aa	A	A	Baa2	Baa2	Baa2	Baa2	Baa3
J&L c/	Ba	Ba	Ba	Ba1	Ba1	Ba1	B3	B2
National	Aa	A	A	Baa3	Ba1	Ba1	B3	B3
Republic c/	A	A	A	Baa3	Ba1	Ba1	B3	B3
U.S. Steel	Aa	A	A	A3	Baa2	Baa2	Baa2	Baa2
LTV	n.a.	n.a.	n.a.	n.a.	n.a.	B1	B1	B1

SOURCE: *Moody's Bond Record*, various editions, as reported in United States International Trade Commission, *Annual Report Concerning Competitive Conditions in the Steel Industry and Industry Efforts to Adjust and Modernize* (September 1986).

NOTE: n.a. = not applicable.

a. Moody's bond ratings are as follows:

- Aaa: Best quality, carrying the smallest degree of risk.
- Aa: High quality. Ranked together with Aaa as high-grade bonds.
- A: Possessing many favorable investment attributes and considered upper-medium grade obligations.
- Baa: Medium-grade obligations, neither highly protected nor poorly secured.
- Ba: Obligations that have speculative elements; their future cannot be considered well assured.
- B: Generally lacking characteristics of desirable investment.
- Caa: In poor standing; may be in default or may present elements of danger with respect to principal or interest.
- Ca: Speculative in a high degree.
- C: Lowest-rated bonds.

In 1983, Moody's modified its ratings. The numbers place the bond's rating within the alphabetic rating. 1 is preferable to 2, which is preferable to 3.

b. Ratings of subordinated debentures are not shown, but these have historically been one rating below the bond ratings shown here.

c. During 1984, Jones and Laughlin (J&L) and Republic merged to form LTV Steel, under the corporate umbrella of LTV Corporation higher where bond ratings are lower. Significantly, bond ratings are based on expectations about a company's future performance rather than on its history, so lower bond ratings represent a negative appraisal of the industry's financial prospects. In fact, following the decline in financial ratings, the industry experienced a wave of bankruptcies, the most notable being LTV Steel. 13/

Any discussion of modernizing the steel industry through new investment elicits the question: how much is enough? What is the likelihood that such investment would return the steel industry to levels of profitability that compare favorably to those of other industries and would be economically viable? An investment goal generated solely from technological criteria may not meet economic standards. In technological terms, improvements in productivity are always desirable because they mean lower costs. But in economic terms, such investment should stop at the point where the expense of investing exceeds the expected benefits. Moreover, the calculation of "the expense of investing" must include the cost of opportunities forgone by not investing elsewhere. Future investment in steelmaking capacity must, in short, compete with other uses of capital, which have outperformed steel investments over nearly two decades. Given the efficiency of today's capital markets, one can expect that if future technological breakthroughs create profitable incentives to invest in steel, adequate investment funds will be available.

13. LTV Steel was formed through the combination of three major steel producers: Jones and Laughlin, Youngstown Sheet and Tube, and Republic Steel.

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CHAPTER II

CAPITAL INVESTMENT AND TAXES

The steel industry has occasionally benefited from special tax provisions--most notably, safe harbor leasing under the Economic Recovery Tax Act of 1981 (ERTA) and a special refund under the Tax Reform Act of 1986. By and large, however, its treatment has been comparable to that accorded most manufacturing industries, which have not fared as well under the tax laws as many nonmanufacturing industries. This chapter outlines the treatment of steel under both tax laws. 1/

Under ERTA, the steel industry enjoyed the benefits given to all manufacturing industries. The effective tax rate on steel investment was no higher than that on investment in most other industries.

The Tax Reform Act of 1986 provides the industry with mixed incentives. The incentives to disinvest in steel, however, are stronger than those to remain. Steel retains $7 billion worth of unused tax benefits that can be used to shelter income from profitable activities in or out of steel, which may strengthen the incentives of companies to diversify away from currently unprofitable steelmaking. On the other hand, the transition rules provide large integrated steel producers with a one-time tax refund in the neighborhood of $500 million, which must be used for steel operations. It seems unlikely, however, that producers will increase their steel activities by that amount.

STEEL UNDER THE OLD LAW

ERTA affected investment in the industry in two ways. First, it provided special incentives for certain activities, including some investments. Second, it introduced a new system of depreciation for corporate assets.

1. Because of the complexity of the new law and the interactions among its provisions, it is difficult to say what the final result of any one provision will be. Different results may obtain as further details are added to the analysis.

Special Incentives

ERTA did not generally provide special incentives for the steel industry. It offered special consideration to some activities--for example, investments in oil or R&D. Moreover, it enabled a number of industries were able to restructure their corporate forms to make better use of existing benefits--for example, by establishing real estate limited partnerships, which passed depreciation or capital gains benefits on to individual partners. Consequently, more funds went into investments that could make use of these tax benefits, rather than into steel. Investment in commercial real estate rose from 10 percent of fixed nonresidential investment in 1980 to over 14.5 percent by 1985. (Other factors, such as rising land prices, mainly drove this increase, but the favorable tax environment played a substantial role.)

The one provision of ERTA that benefited mature industries such as steel--safe harbor leasing--proved so unpopular generally that it was eliminated within one year of its passage. Safe-harbor leasing allowed corporations with excess tax deductions to sell them to taxpaying corporations that could use them to shelter income. In this sense, it paralleled the limited partnerships that were widely used as tax shelters in industries other than heavy manufacturing. A Congressional study has reported that $1.1 billion worth of safe-harbor sales were made in ferrous industries before the provision was repealed. 2/

Capital Depreciation and Effective Tax Rates

Tax laws also affect investment through the way they treat capital depreciation. One way of measuring the tax burden is to calculate the difference between the before-tax and after-tax rates of return on assets, which may be considered the effective tax rate. As commonly calculated, it is the rate that the average firm in an industry will pay on the income generated by the average capital investment in that industry. Since no individual firm is likely to match the average exactly, the effective tax rate is a hypothetical rate, but it reflects the intent of the Congress more than does the average

2. Joint Committee on Taxation, *Analysis of Safe Harbor Leasing* (June 14, 1982). See also Committee on the Budget, *Tax Expenditures: Relationship to Spending Programs and Background Material on Individual Provisions* (March 17, 1982), pp. 167-170.

of actual rates paid. Thus, effective tax rates may be regarded as the incentive structure enacted by the Congress. [3]

In 1985, effective corporate tax rates varied mainly between 15 percent and 25 percent, although in a few industries they were higher or lower (see Table 5). The primary metals industry, of which the steel industry is part, had an effective rate of 23 percent. [4] Assuming that the tax rate of the steel industry was the same as that of primary metals, the industry had an effective tax rate slightly higher than the mean, but not significantly so. While several nonmanufacturing industries were below average, 19 of the 26 industry groups reported had effective tax rates higher than 20 percent. Thus, the rates in Table 1 suggest that the taxes on steel were well within the central trend, and provided no significant incentives or disincentives to steel investment.

Although steel capacity benefited from generous capital consumption or depreciation allowances under the old tax law, these were of little value as steel firms became unprofitable and hence paid no taxes. The inability of steel firms to use their depreciation allowances shows that these rates should be considered as hypothetical. It also shows that the tax system is difficult to use as a mechanism to provide economic incentives since the particular circumstances of the individual taxpayer can easily block the intent of the framers.

STEEL AND THE NEW TAX LAW

The Tax Reform Act of 1986 offers significant benefits to the steel industry, mainly through its transition rules for unused investment tax credits but also by allowing the steel companies to carry forward their net operating losses.

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3. Among other things, these effective tax rates assume that every firm is profitable enough to make use of all its allowable depreciation allowances and that its pattern of investment by asset matches that of the industry as a whole. Estimates are also sensitive to assumptions about inflation and inflation-adjusted interest rates. Consequently, effective tax rates should be used for general comparisons and not to make fine distinctions. For a discussion of effective tax rates, see Congressional Budget Office, *Federal Financial Support for High-Technology Industries* (June 1985), Appendix B and references therein. See also Congressional Budget Office, *Revising the Corporate Income Tax* (May 1985).

4. Congressional Budget Office, *Revising the Corporate Income Tax* (May 1985), pp. 72-75.

TABLE 5. EFFECTIVE TAX RATES ON PLANT AND EQUIPMENT, SELECTED INDUSTRIES, 1985 (In percent)

Category	Effective Tax Rate
Manufacturing	
Petroleum and coal products	32
Furniture and fixtures	28
Transportation equipment, except motor vehicles and ordnance	28
Leather and leather products	27
Printing, publishing, and allied industries	26
Food and kindred products	24
Tobacco manufactures	24
Fabricated metal industries	24
Instruments	23
Primary metal industries (steel)	**23**
Apparel and other fabricated textile products	22
Stone, clay, and glass products	22
Machinery except electrical	21
Electrical machinery, equipment, and supplies	21
Textile mill products	21
Lumber and wood products, except furniture	20
Chemicals and allied products	18
Rubber and miscellaneous plastic products	18
Motor vehicles and motor vehicle equipment	16
Paper and allied products	14
Wholesale and Retail Trade	25
Public Utilities	21
Services	20
Construction	16
Transportation	14
Communication	9

SOURCE: Congressional Budget Office, *Revising the Corporate Income Tax* (May 1985), Table 8.

NOTE: Tax rates are computed under the assumptions of 100 percent equity financing, a 6 percent expected inflation rate, and a real rate of return of 4 percent net of the corporate taxes. The taxpayer is a corporation with a statutory marginal tax rate of 46 percent. Taxes paid by individual shareholders on dividends and capital gains are not counted in the calculation; the tax rate is the corporate-level tax only.

The Transition Rules

The new tax law provides a special transition rule to enable steel companies and farmers to benefit from unused investment tax credits (ITCs) by deducting them from income taxes owed. Because steel companies have been unprofitable and hence have not had tax liabilities, most large integrated companies have not been able to use all the ITCs to which they were entitled under the previous law. Consequently, the Congress included a transition rule permitting them to use their unused ITCs regardless of their current or future profitability.

The rule specifies that qualified companies will be entitled to carry their unused ITCs back to previous tax years and apply them against taxes paid in those years. Unlike the previous law, which provided a three-year carryback period, the transition rule has a 15-year carryback provision. For example, a steel company that has been unprofitable (and unable to use its ITCs) since 1980, can carry its unused ITCs as far back as 1966 (15 years before 1980), cashing them in against taxes paid during that period. 5/ Thus, starting in the first quarter of 1988, at the close of the tax year 1987--the first year covered by the transition rule--the federal government may be writing checks for refunds on ITCs for many major steel companies. Companies in other industries, by contrast, will be allowed to carry their unused ITCs back only three years, and must discount them by 35 percent in 1988.

The amount of unused ITCs held by qualified steel-producing companies totals almost $1.3 billion, but 10 percent to 20 percent are related to nonsteel activities. The Congress also placed several limitations on this transition rule, which could limit the Treasury's exposure to about $500 million. First, unused ITCs carried back are discounted by 50 percent. Second, only a handful of companies are eligible. 6/ Third, the ITCs cannot be carried back before 1962, the year they were introduced. Finally, the refunds must be used in the steel industry for reinvestment and modernization, R&D, retraining of workers, working capital for steel operations, and

5. Of course, there will be no new ITCs at all for any firm as of December 31, 1986, other than credits for rehabilitating old or historical buildings.

6. Companies must--with one exception--have produced at least 1,500,000 net tons of steel in 1983. Companies included in CBO's analysis are Armco Incorporated, Bethlehem Steel, Inland Steel, LTV Corporation, National Intergroup, U.S. Steel, and Wheeling-Pittsburgh Steel.

other appropriate projects. In the case of LTV, which is in bankruptcy, the refunds will be used in steel production or for employee benefits, rather than for paying off creditors.

Although the transition rules require reinvestment in steel, such investment is unlikely to increase by the amount of the refund since the firms cannot be expected to undertake substantial expansion under foreseeable circumstances. 7/ The refund will probably be used largely to replace currently planned expenditures.

According to the CBO steel model, the effect of this refund on the steel industry will be small. Even so, the model seems to overstate the reaction of the industry to the refund. In the model, increased after-tax profits in one period encourage new investment in subsequent periods. But the ITC refund will boost profits in 1988 without adding to the profitability of subsequent investment, and hence it will provide no incentive to reinvestment in steel. According to the model, the effect should be to increase domestic capacity slightly, but to reduce steel employment in subsequent years (see Appendix B). For purposes of simulation, CBO assumed that the transition rule boosts after-tax profits by $500 million in the first quarter of 1988. Under the model, steel companies use part of this money to buy electric arc furnaces, which require less labor than current furnaces, causing the labor force to decrease by a small amount. Productivity rises somewhat, and imports fall by a minuscule amount.

Permanent Features of the Tax Law

After the transition, the new law will affect steel investment in two ways: in the treatment of net operating losses, and in the depreciation of capital equipment.

Net Operating Losses. In recent years, the steel companies have accumulated roughly $7 billion worth of net operating losses (NOLs). 8/ These can be carried forward as an offset against future profits on which the companies would otherwise have to pay taxes. A company's use of NOLs is

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7. Being in bankruptcy, LTV for one is not likely to expand its capacity.

8. In the fall of 1986, the major steel companies had accumulated over $7 billion worth of NOLs. Salomon Brothers, "The Domestic Steel Industry--Of Taxes and Acquisitions" (October 15, 1986).

not restricted to the lines of business in which the NOLs were incurred; it can use them to offset income earned in other industries. This accumulation of NOLs ensures that, by and large, steel companies will not be paying taxes for several years once they return to profitability.

The new bill makes several changes in the treatment of NOLs. Most important, it seeks to ensure that firms with NOLs do not become candidates for takeover merely because of them: if 50 percent or more of a firm's ownership changes, the percent of outstanding NOLs that can be used in any one year will be substantially reduced, and their use will be disallowed entirely if, in the two years following any ownership change, a company changes its line of business. 9/

The value of the NOLs has been reduced by the new law, however. The fall in the top marginal tax rate from 46 percent to 34 percent lowers the tax liability that can be offset with each dollar of NOL. Also, NOLs can no longer be used to offset completely the minimum tax.

The new tax law will further encourage steel companies to diversify outside the industry. They will be at an advantage in bidding for new business against firms without a substantial level of NOL carryforwards, simply because they can shelter from taxes most of the profits associated with the new business. Moreover, the lack of substantial profits in most of the steel industry encourages companies to invest outside the industry so as to use their NOLs--for example, by buying existing firms with positive and sizable income streams. NOLs enable steel companies to make investments that pay a before-tax rate of return below market rates but yield after-tax returns equal to market rates. In short, the NOLs act as a subsidy for steel company investments in takeovers.

Steel companies, however, face a problem in this respect. They cannot make such investment in small increments; companies must be bought in large discrete amounts. 10/ Because the structure of capital in the steel industry is already skewed heavily toward debt, which might otherwise be used in finance takeovers, a steel company would have to accumulate investment funds and await the opportunity to make a sizable purchase. Thus,

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9. U.S. Congress, Conference Report on H.R. 3838, Tax Reform Act of 1986, Managers' Report, Title VI, Subtitle H.

10. While some profitable companies available for takeover are small, the transaction costs of takeovers and limited management time would seem to favor large takeovers.

capital constraints, combined with the expectation of unprofitable returns from large investments in steel, may combine to discourage even incremental investments in steel, because scarce investment funds will find the highest return if used to diversify elsewhere.

The new tax law undertook to reform the tax structure by eliminating most tax preferences, notably that for capital gains, and by reducing the passthrough of passive losses in limited partnerships. These two provisions of the law had been widely used to design tax shelters in industries such as real estate, oil and gas, and timber. Steel companies will no longer be bidding against tax shelters in these areas.

A negative aspect of the new law's treatment of NOLs is that it could encourage poorly run firms to take over well-run firms. As noted above, if outsiders take over a company having NOLs, their use of them will be limited under the new law while no such limits are placed on the use of NOLs by the management that incurred them. To the extent that losses reflect on the quality of management, the NOL restrictions may spur bad management to buy out good management.

Effective Tax Rates and Future Steel Investment. In its capital depreciation system, the new tax law treats investment much more neutrally than did the old law, which tilted toward certain investments and activities. 11/ If the new capital cost recovery system does not favor the steel industry, neither does it favor industries that are competing with steel. Investment patterns will be determined by the market rather than by the Congress.

For instance, under the old law the aircraft manufacturing industry had an effective tax rate less than one-half the manufacturing average. 12/ Under the new law, the two have the same rate. The effective tax rate in steel is 31 percent, almost the same as the manufacturing average, which is 32 percent. (Under the old law, the steel rate was 23 percent and the manufacturing average 22 percent.) The net effect of the bill has thus been to narrow the range of corporate rates, but it has done so by raising many of them. From the perspective of the steel industry, the question is whether the narrowing of the gap between steel and other investments is worth the higher absolute level.

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11. This discussion does not deal with the question of the law's asymmetrical treatment of profitable and unprofitable firms.

12. Congressional Budget Office, *Federal Financial Support for High-Technology Industries* (June 1985), p.46.

CONCLUSIONS

In the main, the tax law will only reinforce negative signals provided by the industry's chronic overcapacity and lack of profits. Were there opportunities for substantial profitable investment in steel, the same tax advantages that are driving the companies out of steel would induce them to invest in their own industry. Tax reform will provide a substantial amount of capital to the industry through the ITC refund and the restrictions on outsiders' use of NOLs. Moreover, these advantages are accruing to steel at the same time that other industries are losing theirs. Viewed only from the tax perspective, steel firms are thus in a good position to make capital investments, though not in steel.

Under the previous law, many investments were favored in a way that steel investment was not. The new law ends preferential treatment for long-term capital gains and places limits on the use of NOLs derived from passive sources to offset other income. Consequently, steel investment will less often have to compete in capital markets against tax-preferred industries, but steel investment will continue to suffer even under tax reform.

CHAPTER III

FEDERAL FUNDING OF STEEL RESEARCH

Federal government agencies currently fund about $26 million a year in research that could aid innovation in the steel industry.[1] As shown in Table 6, the Department of Energy spends approximately $6.9 million on research into energy-saving steel processing techniques. The National Science Foundation spends about $8 million on basic research into manufacturing processes and the uses of steel. The Department of Interior's $5 million funding focuses on the conservation and reuse of scarce inputs into steelmaking. The National Bureau of Standards spends $1.9 million on research into the effects of various aspects of steelmaking on quality control; it is also developing sensors that will help steel manufacturers produce high-quality steels. The Department of Defense spends $4.5 million on developing better and/or less expensive steels for the special needs of military construction.

In addition to direct spending, the federal government also gave the steel industry $2.1 million in research and development tax credits in 1983.

The industry itself spends roughly $400 million on its research programs. This amount is equal to 0.6 percent of sales, as compared with about 2.6 percent for the average manufacturing industry. The federal research spending mentioned above equals another 0.04 percent of sales, while the federal research effort for all manufacturing is 1.2 percent of sales.

DIRECT FEDERAL FUNDING

This section describes the research that is funded directly by federal government agencies.

1. Because the research has a broad focus, many agencies cannot determine a precise dollar amount for what they spend on steel research. The figures used here are based on the best guess of the contracting agency.

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TABLE 6. FEDERAL FUNDING OF STEEL-RELATED RESEARCH

Agency/Program	Description	Amount (millions of dollars)
Department of Energy		
Office of Industrial Programs		
U.S. Steel-Bethlehem Steel	Thin-slab continuous casting	30 over five years
Westinghouse Electric-Armco	Thin-strip continuous casting	2 over three years
Sensors Development		1 over four years
Office of Fossil Energy		
Weirton Steel	Clean Coal Technology Program	In negotiation
National Science Foundation		
Miscellaneous grant programs		1.1 to 1.4
Materials Research Labs		
M.I.T.	High-technology steels	1.12
University of Pennsylvania	Micromechanics of interfaces	1
Northwestern University	Corrosion	0.2
Harvard University	Micromechanics of materials	0.3 to 0.35
Brown University	Large strain deformation and fracture of materials	1
Industry-University Cooperative Research Centers		
Colorado School of Mines	Steel processing	0.1 to 0.125
Carnegie-Mellon University	Steel making	0.1 to 0.125
Engineering Research Centers		
Lehigh University	Large scale structural systems	1.4
Ohio State University	Net final shape manufacturing	1.25
Department of the Interior		
Office of Minerals and Materials Research		5
National Bureau of Standards		1.9
Department of the Navy		
David W. Taylor Naval Ship Center		
High strength-low alloy steels development		1.8
Modification of commercial steels		0.45
Title III of the Defense Production Act		Up to 120
Office of Naval Research	Welding	1
Naval Research Lab	Advanced ferrous alloys	0.4
Naval Sea Systems Command	Types of control in HSLA steels	0.35
Department of the Army		
Army Materials Technical Lab	Better steel performance in armor	0.47

SOURCE: Congressional Budget Office.
NOTE: These figures are agency estimates of fiscal year 1986 expenditures except for Title III of the Defense Production Act, which is still under development. In this case, the agency's estimate of total expenditures is given.

Department of Energy

The Department of Energy (DOE) funds research into processes that will lessen energy consumption in steel production. The most promising methods are those aiming at a more continuous steelmaking process. DOE is planning to pursue one such method in conjunction with a program to promote the "clean" use of coal.

Traditionally, steelmaking has consisted of four stages: preparation of the raw inputs of iron ore and coal; production of steel; production of semi-finished steel shapes; and production of finished products. Much of the recent progress in eliminating steps (thus lowering costs and reducing the use of energy) has occurred in the production of semifinished steel shapes. In the past, steelmakers formed semifinished shapes by allowing molten steel to harden into ingots, which later would be reheated and rolled. Increasingly, manufacturers have turned to continuous casting, in which molten steel is formed directly into semifinished shapes without cooling into ingots.

DOE is funding two major projects in continuous casting technology. One, with U.S. Steel and Bethlehem Steel, is a five-year effort to bring on line a pilot plant that would cast steel from a molten state to one-inch-thick slabs. DOE has obligated $16 million over the first three years of this project. It anticipates spending a total of $30 million.

The second is a project with Westinghouse Electric and Armco to develop a wheel casting process that would produce steel strips three inches wide and half an inch thick. DOE expects to spend $2 million on this project over three years.

DOE is also working, in coordination with the National Bureau of Standards, on the development of sensors to measure internal temperature distributions in hot steel slabs, which could lead to improvements in productivity and energy efficiency. DOE has spent $1 million on sensor development over the last four years.

The Congress also has charged the Department of Energy with oversight of the Clean Coal Technology program, designed to demonstrate commercial feasibility of industrial coal technologies that conform with emission levels set by the Clean Air Act. DOE has solicited bids under the program and currently is negotiating contracts. One of the winning bidders is Weirton Steel, which has proposed construction of a demonstration plant to reduce iron ore directly. Direct-reduction techniques replace blast furnaces and coke ovens with less capital-intensive processes. Oil- and gas-based reduction techniques are already in commercial use in areas where fuel prices are low. Coal-based reduction, an even less expensive process, could be more widely competitive. While the contract is still under negotiation, industry sources suggest that it will be in the range of $180 million. DOE will pay 35 percent of the cost.

National Science Foundation

The National Science Foundation (NSF) funds basic research, although often with an eye toward future applications. NSF spends $3 million to $4 million on steel-related research. Of that, $1.1 million to $1.4 million is used to fund directly about 80 small grants. The rest is spent on three types of cooperative research centers, many of which also have industry funding.

One type of center that NSF funds is the Materials Research Lab type (MRL), devoted to multidisciplinary research. MRLs at five universities have steel as one of their major research (or "thrust") areas: the Massachusetts Institute of Technology (high-technology steels); the University of Pennsylvania (micromechanics of interfaces on steels and iron-based alloys); Northwestern University (corrosion); Harvard University (a related project on how the nature of materials affects their mechanical behavior); and Brown University (large-strain deformation and fracture of metals).

NSF also gives seed money for the start-up of industry-university cooperative research centers that will focus on science and engineering topics relevant to industry. Two centers that are still in their five-year start-up phase and are therefore receiving NSF money are engaged in steel research: at the Colorado School of Mines (steel processing) and at Carnegie-Mellon University (steelmaking). NSF's funding of each of these centers (at a total of $200,000 to $250,000) is in its third year.

Two years ago, NSF began funding engineering research centers to enhance the international competitiveness of U.S. industry. Funding is not guaranteed for any specific period, but will be evaluated three years into the funding cycle. The engineering research center at Lehigh University (which receives $1.4 million from NSF) looks at new techniques for building large-scale structural systems (buildings, bridges). (Of this, the research most relevant to the steel industry is into lessening corrosion.) The engineering research center at Ohio State University (which receives $1.25 million from NSF) investigates getting steel and other metals as close to final shape as possible during the initial manufacturing processes.

Department of the Interior

The mission of the Bureau of Mines (BOM) is to achieve a more efficient use of strategic materials. Some strategic materials are inputs into steel; others are used in steel processing and then discarded; still others are found in steel scrap. While BOM's research clearly is not intended to aid innovation in the steel industry directly, some of its projects could develop processes that would have such an effect. For example, its research into methods of recycling strategic materials presently lost in steelmaking might aid in developing new, less expensive methods of steel processing. An ability to recycle strategic minerals from steel slag would also lower the costs of steel production by creating usable byproducts.

BOM spends $5 million a year on research that could potentially aid the steel industry. Some of the projects it funds include: enhancing the properties of iron ore pellets used as input into the steelmaking process; exploring trends in the quality of iron scrap, which is used in minimills; improving the efficiency of the pickling baths used to clean processed steel, and recovering more of the nickel and chromium currently discarded from used bath solutions; and improving energy efficiency in electric furnace steelmaking.

National Bureau of Standards

The National Bureau of Standards (NBS) provides industry with broad-based support in measurement technology and standardization. NBS has a metals research program, many aspects of which encompass steel, but until recently it did not have a separate steel research program. In January 1986, as part of the Keyworth steel initiative, the Congress appropriated $1.9 million for NBS steel research. NBS expects to get almost as much in fiscal year 1987. The purpose is to develop the technology for measuring and maintaining high quality control in steel production. About half of the steel initiative money is being spent on the development of sensors to be used as solidification process controls. Other research areas include: measuring the size and shape of imperfections in finished steel; modeling the solidification process for continuous casting; and bioprocessing scrap and ore (already being done in copper processing).

Department of Defense

The goal of the steel research programs in the Department of Defense (DoD) is to develop better and/or less expensive steels for naval construction and, to a lesser extent, for armor. The benefits to the steel industry depend on the extent to which improved practices and new steels developed by DoD are applicable to commercial uses.

The David Taylor Naval Ship Research and Development Center funds most of the steel research conducted by DoD. The Center is spending $1.8 million this year on its ongoing development of a new high-strength/low-alloy steel (HSLA) that will be less expensive to weld than the steels now used in naval construction, but without any loss of properties. In the beginning, HSLA steels would be used only in those applications where the high strength of naval steel is not needed, but they might eventually replace standard high-strength steels. The Center is also spending $450,000 in basic research on modifying commercial steels that are currently almost good enough for naval use. The research covers high-strength steels and lower-strength steels that the industry is in the process of developing for commercial uses.

The Defense Department hopes to implement Title III of the Defense Production Act beginning in fiscal year 1988. Under Title III, DoD would subsidize an American steel producer's upgrading of a mill to make it capable of producing HSLA steels; DoD would commit itself to purchasing its next five year's HSLA steel requirements from that mill. The goal is to reduce the high cost of alloys used by DoD, and to reduce the need for imported chromium, recognizing that limited commercial markets exist for HSLA steels and that a manufacturer would take a large financial risk in upgrading without the guarantee of a market. In Phase I of Title III, DoD will certify steels for use in military construction. In Phase II (beginning in fiscal year 1990), it will bring a plant on line. DoD expects to spend $20 million on the plant upgrade and $90 million on the subsequent steel purchases.

The Defense Department is funding a number of other steel-related research projects. These include research into welding sciences, fluxes, and model arc welding, in the hope of reducing welding costs; research into advanced ferrous alloys and the modeling of alternative low-carbon advanced ferrous alloys; research into the complementary subject of types of control in HSLA steels; and research into materials modification and new armor applications of certain types of steel that have not been tried previously. DoD is spending $2.2 million on these projects.

RESEARCH AND DEVELOPMENT TAX CREDIT

Because the steel industry performs very little research on its own, the incremental research and development tax credit does not provide much R&D support for the steel industry. In 1983, the most recent year for which data exist, the industry applied for $2.1 million worth of credit. 2/ The smallness of the tax credit can best be explained by examining corporate R&D spending. In 1984, the steel industry spent $390 million on R&D, an amount equal to 0.6 percent of sales, while the average manufacturing industry spent 2.6 percent of sales on R&D. Moreover, steel R&D spending has been essentially flat since 1981, while aggregate corporate R&D has risen by over a third. 3/ A lack of taxable profits may also help explain the low level of R&D in steel.

2. The data are based on preliminary returns. See *Internal Revenue Service Source Book 1983*, Statistics of Income, Corporation Tax Returns, p. 89.

3. National Science Foundation, *Research and Development in Industry* (1984). For a detailed discussion of the R&D credit, see Congressional Budget Office, *Federal Financial Support for High-Technology Industries* (July 1985).

CHAPTER IV

IMPORT RESTRAINTS, MERGERS, AND PLANT CLOSINGS

The federal government has intervened from time to time to help the steel industry reduce its costs and increase its international competitiveness. Chapters II and III discussed efforts to spur modernization by means of tax incentives and R&D grants. On at least three occasions Washington has also imposed restraints on imports, without much success. Other ways in which the government has affected or could affect the industry include relaxing the restrictions on mergers and acquisitions or absorbing some of the costs of eliminating excess capacity. This chapter considers these three approaches to increased competitiveness.

IMPORT RESTRAINTS

Perhaps the most visible manifestation of the steel industry's decline is rising imports. Trade restraints are seen as a means of increasing domestic production and profitability, thus providing the industry with the resources to invest in more efficient facilities.

The government has initiated major protective measures on three separate occasions. During the late 1960s, it negotiated voluntary restraint agreements with Japan and the European Economic Community. In the late 1970s, it established a trigger price mechanism to discourage foreign steelmakers from dumping their products on the U.S. market at less than their own costs. Finally, in 1984, President Reagan ordered the negotiation of voluntary restraint agreements with major exporters after the U.S. International Trade Commission found that the domestic industry had been injured by imports.

The First Two Episodes of Major Protection

A sharp rise in steel imports during the 1960s, at a time of stagnant growth in domestic production, led to calls for trade protection. Both Japan and the European Economic Community agreed to limit their exports of steel products to the United States for three years beginning in 1969. The agreements were extended for another three years after they expired. 1/

The agreements had, however, little real effect on the steel industry. A recession slowed domestic consumption in 1970, creating a smaller market for domestic producers, despite the restraints. In 1973 and 1974, during a worldwide steel boom, domestic steel prices were controlled. Imported steel prices rose rapidly, and demand for domestic steel surged. Moreover, imports from unconstrained sources grew during the period of controls. As a result of those factors, the limits on steel imports did not increase demand for domestic steel by much and for most of the period industry profits were lower than they had been. According to the CBO steel model, the voluntary restraint agreements did not significantly affect the quantity of imports, and consequently they did not increase domestic prices and output. Moreover, through much of the period that the restraints were in effect (1969-1974), investment in the industry declined.

In response to a new surge of steel imports, the United States instituted the trigger price mechanism in 1977. Domestic steel producers maintained that foreign producers were dumping steel in the United States--that is, selling it below their own costs. To dissuade them, the United States established trigger prices; foreign producers selling steel below the costs of efficient Japanese producers were subject to accelerated antidumping proceedings: those found guilty of dumping would be subject to countervailing duties. Like the voluntary restraint agreement, however, this episode of protection did not lead to a substantial improvement in the industry's output, profitability, or investment. For example, the CBO steel model indicates that the trigger price mechanism did not have a significant effect on the price of imports or demand for domestically produced steel. Basing the trigger prices on the costs of efficient Japanese producers essentially gave less efficient firms in other countries a license to dump.

The Current Round of Protection

In September 1984, President Reagan instructed the United States Trade Representative to negotiate voluntary export restraint agreements with countries that are the principal exporters of steel to the United States. The

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1. For a more detailed discussion of the effects of the voluntary restraint agreements and the trigger price mechanism, see Congressional Budget Office, *Has Trade Protection Revitalized Domestic Industries?* (November 1986), pp. 39-58.

goal was to reduce steel imports from nearly 27 percent of U.S. steel consumption in 1984 to 20.2 percent. 2/ Imports subsequently fell to roughly 25 percent of U.S. consumption in 1985 and to a little over 23 percent in the 12 months ending October 1986. Even without the restraint agreements, import penetration would probably have fallen because of the declining value of the dollar. In any event, the 20 percent target proved unattainable; apparently the goal now is to limit imports to about 23 percent. The lower target has been difficult to reach, in part because of the rapid growth of imports from producers not subject to the restraints.

Since the current restraint program is only in its second year, its effects cannot be fully judged. The industry continues to lose money, however, and two integrated producers--Wheeling-Pittsburgh and LTV--have declared bankruptcy. Moreover, the International Trade Commission reports that in the 12 months ending June 1986, capital expenditures in the industry declined by 25 percent. 3/

Simulations with the CBO steel model indicate that the current trade restraints may not substantially improve the industry's competitiveness. If the restraints were to achieve the revised goal of limiting import share to 23 percent through 1989, total investment during the period would be less than 1 percent higher than it would have been without the quotas. Appendix B contains estimates from the model. Even without the restraints, the model finds that the share of imports may be less than 23 percent in 1987 and 1988 because of the declines in the value of the dollar. Thus, over the life of the program, the restraints would lift industry shipments by less than one-half of 1 percent. In 1990, the year after the quotas lapse, both domestic shipments and imports would be at the same levels as if there had been no quotas.

To gain further insights into the ability of quotas to revitalize an industry, CBO considered the effects of limiting import share to 20 percent through 1992. Essentially, this means assuming that the President's program achieved its original goals and was extended for three more years. The CBO steel model projects that total capital expenditures during the eight years would be 7 percent higher than without the quotas. During this period, total

2. See David J. Cantor, "The President's Steel Import Program: One Year Later," Congressional Research Service, processed, October 16, 1985.

3. See U.S. International Trade Commission, *Annual Survey Concerning Competitive Conditions in the Steel Industry and Industry Efforts to Adjust and Modernize* (Washington, D.C.: USITC, September 1986).

domestic shipments would increase by 7.4 percent, and employment would be correspondingly larger as well. Because of the greater operating rates and the increased investment, the average cost of producing steel would decline by 3.3 percent. These limited gains would be costly, however. The combined average price of domestic and imported steel in 1992 would be 4.4 percent higher. 4/ The gains would also be short-lived. Because of the limited increase in investment, the competitive position of the domestic industry would probably not be substantially improved once the quotas were removed.

Trade policy has not, therefore, had as pronounced an effect on the domestic steel industry as is commonly supposed. The primary reason why protective programs fail is that they do little to increase the profitability of cost-reducing investments. If new plant and equipment could reduce the average cost of making steel by 10 percent, it would do so whether or not the industry was protected. 5/ Neither can protection be expected to produce new technologies that overcome the sources of the industry's cost disadvantage. Moreover, by limiting competition, protection may reduce firms' incentives to make new and potentially risky capital expenditures. 6/

MERGERS, ACQUISITIONS, AND ANTITRUST POLICIES

Firms may be able to reduce their costs through merger and acquisition, to the extent that this enables them to make more efficient use of capacity or brings them a necessary infusion of capital or management expertise. They are limited by the antitrust laws, however, which prohibit mergers and acquisitions that are expected to raise prices significantly. Some merger proposals have been altered or abandoned for this reason, and others may have been deterred.

4. The price of domestic steel would be up less than 1 percent. Higher prices for imported steel account for the bulk of the 4.4 percent increase.

5. In the Trade and Tariff Act of 1984, the Congress encouraged modernization by requiring steel firms, which had just been awarded protection by President Reagan, to reinvest the bulk of their cash flows in the industry.

6. For a discussion of trade protection's role in increasing the international competitiveness of steel as well as other industries, see Congressional Budget Office, *Has Trade Protection Revitalized Domestic Industries?* (November 1986).

Reducing Costs Through Mergers

Mergers and acquisitions can reduce costs in a number of ways. Consider, for example, two companies that produce similar products, both of them operating at substantially less than capacity. While both may be unprofitable, neither firm will shut down its operation so long as sales cover its out-of-pocket costs. (In fact, a firm may continue to manufacture a product that does not cover its out-of-pocket costs, if the product complements the sale of other products that are profitable, or if continued operation avoids the cost of retiring the excess capacity.) If the two firms combine operations, the new firm can trim its extra capacity but continue to sell to all the customers previously served.

Even where firms do not maintain substantial excess capacity, a merger or an acquisition may permit cost reductions. For example, if two firms sell products to the same customers, combining permits better use of sales and marketing resources. Similarly, a combination may allow firms to coordinate production among facilities; this coordination can permit cost reductions through greater specialization in multiproduct plants.

A lack of capital or management talent may limit a firm's effective use of its resources, making it an attractive takeover candidate for another firm with the necessary funds or managerial expertise. Firms outside the domestic steel industry, particularly foreign steel producers, are the most likely to make acquisitions for this reason.

Mergers, Acquisitions, and Joint Ventures

Over the last 10 years numerous domestic steel manufactures have been acquired or have merged. Most of them were relatively small companies, so there was little concern that the prices of their products would rise as a result. 7/ In two cases, however, antitrust laws clearly played an important role.

In 1983, LTV announced that it would acquire Republic Steel to create the second largest steel company in the United States. The Department of Justice decided not to contest the merger, but only after LTV agreed in

7. For a list of mergers and acquisitions involving domestic steel producers, see Mark W. Frankena and Paul A. Pautler, *Antitrust Policy for Declining Industries*, Federal Trade Commission, Bureau of Economics, Staff Report (October 1985), pp. 44-45.

1984 to divest some of Republic's facilities. An important goal of the LTV-Republic merger was to reduce costs by rationalizing capacity. This goal was apparently not met. In July 1986, two years after it had acquired Republic, LTV declared bankruptcy.

In February 1984, U.S. Steel (now USX), the nation's largest steel manufacturer, announced plans to acquire the seventh largest producer, National Steel. Opposition by the Department of Justice was one of the factors that led U.S. Steel to drop the proposal only a few months later.

Efforts of the government to protect steel against import competition have been a factor in the Department of Justice's analyses of both of these merger proposals. Restraints on imports could enable the merged producers to raise prices. The Department of Justice therefore reasoned that, because of the restraints, the merger was likely to increase domestic steel prices. To some extent, then, trade policy and antitrust enforcement appear to operate at cross-purposes. One aims at increasing competition and the other at limiting it.

Joint ventures are another form of combination. These are frequently aimed at producing a new product, like the decision of U.S. Steel and Ford's steel subsidiary to produce galvanized steel. Bethlehem and Inland also recently agreed to collaborate on the production of new steel products. [8]

A number of foreign producers have invested in the domestic steel industry. Most notably, Nippon Kokan, Japan's second largest steel company, acquired 50 percent of National Steel in April 1984. A few months earlier Nisshin, Japan's sixth largest producer, bought 10 percent of Wheeling-Pittsburgh's stock. While at the time of the transactions the domestic firms hoped that their Japanese partners would be a source of additional capital, the arrangements have apparently provided only limited benefits. [9] Wheeling-Pittsburgh declared bankruptcy the following year, and ground has not yet been broken on a joint venture announced when Nisshin made its investment. In addition, National Intergroup, the domestic firm that owns half of National Steel, is reportedly trying to sell its

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8. Department of Commerce, *1986 U.S. Industrial Outlook* (January 1986), p. 19-3.

9. "LTV Chapter 11 Filing Will Change the Way Steel Mills Compete," *Wall Street Journal*, July 18, 1986, p. 9.

share.[10] Several Canadian producers own substantial stakes in a number of nonintegrated producers. For example, Ivaco owns a large share of both Atlantic Steel and Laclede; Costeel built Raritan River. California Steel is a joint venture of Brazilian and Japanese producers, operating the flat roll and plate facilities that formerly belonged to Kaiser Steel. It uses semi-finished steel primarily from Brazil.

Joint ventures between domestic and foreign producers include LTV and Sumitomo's production of electrogalvanized steel, and a joint venture between U.S. Steel and Korea's Pohang Iron and Steel Company to make sheet steel on the West Coast. Several other joint ventures are reportedly being considered.

Relaxing Antitrust Standards

Aside from the merger of LTV and Republic, and the proposed acquisition of National by U.S. Steel, antitrust laws do not seemed to have played much of a role in discouraging steel combinations. Nevertheless, a relaxation of antitrust standards for steel mergers might favor investment in the steel industry if the mergers were seen as leading to reduced capacity or other cost savings. In the event that a merger enabled the domestic industry to raise prices significantly, an agency like the International Trade Commission might be given the authority to relax the existing restraints on imports. It seems unlikely, however, given the industry's problems, that an easier anti-trust policy would significantly lower the cost of producing steel. The recent bankruptcy of LTV reinforces this view. Any benefit from a relaxed antitrust standard would be more likely to come from permitting the industry to raise prices. From this perspective, liberalizing merger policies might further an aim of trade protection--raising prices and profitability in the domestic steel industry.

REDUCING CAPACITY

The decline in steel consumption has not only limited the incentives of steel manufacturers to invest in new plant and equipment; it has left the industry with substantial excess capacity. In the 1970s, the domestic steel industry's

10. See, for example, "Wheeling To Sell 10% To Nisshin," *New York Times*, February 8, 1984, p. D1; and "National in Japanese Steel Deal," *New York Times*, April 25, 1984, p. D1.

capacity utilization rate was well in excess of 80 percent, and as recently as 1981 it was 78 percent. After closing 13 percent of its capacity since then, the utilization rate was only 65 percent in 1985. Further reductions are apparently still needed.

A number of factors impede the rationalization of capacity. Existing labor agreements make it very expensive to lay off workers. Closing facilities may place some producers in technical bankruptcy because of covenants on outstanding loans. Finally, a number of steel companies have negotiated long-term contracts with suppliers that commit them to purchase minimum amounts of power and raw materials such as coal and ore.

Employees of integrated steel firms receive full retirement benefits if they have been employed for 30 years, and those over 60 can retire with even fewer years of service. The amount of the pension is determined by a formula combining salary, years of service, and age. For the most part, these pensions are intended to be fully funded by employer contributions made while the workers were employed.

Integrated steel producers also provide full pensions to certain workers when they are laid off before becoming eligible to retire. When large numbers are laid off, the cost of these provisions can be substantial. Such workers can receive full pensions with as little as 15 years of service if they are 55 or over, and those under 55 are eligible if the sum of their age and years of service is at least 80. Workers with 20 years of service who do not meet these criteria may also qualify for pension benefits. Laid-off employees who qualify for these special benefits are entitled to additional cash grants until they are 62, when they become eligible for Social Security. The steel firms also provide medical insurance for them.

Since employers' contributions to pension plans are largely based on previous experience, the pension funds' resources often will not entirely cover the obligations that are created when terminations exceed the historical rate. The amount of the deficiency is a liability on the firms' books. If a company is already in financial difficulty, the increase in liabilities can exceed its net worth and throw it into bankruptcy.

In the steel industry, such obligations to laid-off workers have affected operating decisions. A firm operates a plant so long as the revenues exceed the out-of-pocket costs, principally those for materials and labor. Pension plans in the steel industry, however, have turned part of the operating costs into a fixed cost--that is, laying off workers results in a substantial liability that is not affected by subsequent changes in output.

Since steel companies can avoid only part of workers' wages through layoffs, they tend to keep more capacity operating than would otherwise be justified. The pension arrangements also reduce their incentives to invest in labor-saving equipment. (Similarly, to the extent that a company has long-term contracts with materials suppliers requiring it to pay for inputs whether they are used or not, these inputs will also be considered fixed costs in making operating decisions.)

At present, when a company goes bankrupt the federal government's Pension Benefit Guaranty Corporation (PBGC) generally assures that workers covered by the plan receive their benefits. In return, the PBGC is entitled to certain assets of the bankrupt firm. A firm can thus be relieved of the liabilities of laying off workers by declaring bankruptcy and may then continue to operate under Chapter 11 of the Bankruptcy Code. This policy essentially subsidizes the least efficient firms, since they are the ones most likely to go bankrupt.

The government could aid the industry by agreeing to pay some of the costs associated with contraction without requiring firms to declare bankruptcy. Specifically, it could absorb some of the underfunding of pensions that arises in laying off workers. This assistance would make it easier for steel companies to cut back their operations and at the same time would enable them to devote more resources to modernization. Such a plan might be designed to assist all companies, whether or not they were on the brink of bankruptcy.

There are several arguments against this proposal. Lowering the cost of reducing capacity would undoubtedly help the industry, but would still leave it with high raw material costs and antiquated facilities. If the government underwrote expensive labor agreements in the steel industry, it could not refuse to do so for other industries as well. Finally, some firms have covenants in their loan agreements requiring them to maintain a given ratio of debts to assets; a firm might be forced into bankruptcy if closing a facility (reducing assets) deprived it of a source of financing.

CHAPTER V

THE EFFECTS OF ENVIRONMENTAL REGULATION

Federal and state programs designed to protect the environment impose a wide range of costs on all domestic industries. The iron and steel industry has been a major focus of these efforts, since it may be responsible for as much as 10 percent of all particulate air emissions and 15 percent to 20 percent of all conventional industrial water discharges.[1] Not surprisingly, the industry's costs under environmental regulatory programs have been fairly substantial. Throughout the 1970s, expenditures on new plant and equipment for pollution control ranged from 10 percent to 20 percent of total capital spending in the industry.[2] The impact of these expenditures on the industry's profitability has been a matter of continuing debate.

The conventional wisdom concerning the economic impact of environmental regulation on the iron and steel industry relies on several related propositions. First, the required capital expenditures displace other, more productive investments. Second, the operating and maintenance expenses associated with pollution control activities raise production costs, leaving producers at a competitive disadvantage against foreign producers of iron and steel, some of which are not subject to the same stringent requirements. While these effects seem obvious, most empirical research suggests that they are in fact relatively unimportant as compared with other difficulties facing the industry (such as those discussed elsewhere in this report).

For several reasons, it is difficult to isolate the impact of past and current environmental regulations on the economic status of the industry. The models used by analysts, as well as the available pollution control cost

1. The air pollution estimates are drawn from air and water emission data bases as described in: U.S. Environmental Protection Agency, *NEDS National Emission Data System Information* (Research Triangle Park, N.C.: U.S. Environmental Protection Agency, November 1984); and Leonard P. Gianessi and Henry M. Peskin, *The RFF Environmental Data Inventory* (Washington, D.C.: Resources for the Future, April 1986).

2. McGraw-Hill Economics, *19th Annual McGraw-Hill Survey of Pollution Control Expenditures, 1985-1987* (New York: McGraw-Hill, May 1986).

data, do not provide a particularly reliable basis for estimating the economic effects of environmental cleanup. Further, most existing estimates of economic impacts were conducted in the late 1970s and early 1980s before the major industry downturns experienced in 1982-1984. None of these studies anticipated the substantial deterioration in the industry's economic condition. Nevertheless, they provide a basis for understanding the possible relationships between environmental regulation and the health of the industry.

POLLUTION CONTROL EXPENDITURES

Surveys and engineering studies of actual (or planned) expenditures on pollution abatement offer a crude but useful picture of the initial economic effects of environmental regulation on the industry. Table 7 presents vari-

TABLE 7. IRON AND STEEL INDUSTRY POLLUTION CONTROL COSTS, 1981 (In millions of 1981 dollars)

Source	Capital	Annual
Environmental Protection Agency a/	329	1,600
Survey of Current Business b/	610	
McGraw-Hill c/	452	
Bureau of the Census d/	459	1,221
American Iron and Steel Institute e/	518	

a. U.S. Environmental Protection Agency, "The Cost of Clean Air and Water: Report to Congress 1984" (May 1984).

b. U.S. Department of Commerce, *Survey of Current Business* (June 1982).

c. McGraw-Hill Economics, *19th Annual McGraw-Hill Survey of Pollution Control Expenditures 1985-1987* (New York: McGraw-Hill, May 1986).

d. U.S. Department of Commerce, *Pollution Abatement Costs and Expenditures, 1981* (May 1982).

e. American Iron and Steel Institute, "Capital Expenditures by Iron and Steel Companies for Domestic Environmental Control and Solid Waste Disposal Facilities," AIS 17EC (Washington, D.C.).

ous estimates of capital and operating and maintenance expenditures incurred in 1981, the most recent year for which comparable data were available.[3] Pollution control capital expenditures as a percent of total capital expenses in 1981 appear to be in the range of 13 percent to 15 percent (using McGraw-Hill and Commerce Department estimates, respectively). Further, according to the McGraw-Hill survey, pollution control expenditures as a percent of capital spending have been declining steadily from a high of 19.9 percent in 1979 to 5.2 percent in 1984. (This is consistent with the facts that by the mid-1980s many of the capital investments associated with air and water pollution control had already been made for existing facilities, and that capital expenses to comply with the emerging hazardous waste rules are substantially smaller.) Annual costs (including operating and maintenance expenses) of pollution control were estimated in the range of $1.2 billion to $1.6 billion in 1981.

It is difficult to select the best estimate from among the existing expenditure and cost figures. Differences in methodology, in underlying assumptions, and in the types of pollution control costs included give no basis for preferring one estimate to another.[4] Annual capital costs in the range of $500 million, even though declining over the 1979-1984 period, would represent a significant portion of total investment in the iron and steel industry. Given the constraints on the industry's ability to raise capital in the last several years, it is possible that environmental control expenditures could have displaced some investments in "productive" activities. The extent to which this displacement may have contributed to the industry's current problems is discussed in the next section.

The Economic Impact of Pollution Control Expenditures

One, now dated, study of the economic impact of environmental regulations on the iron and steel industry suggests that the increased expenditures may

3. The variations in the reported estimates reflect different survey methodologies and engineering assumptions underlying the estimates, and the different media covered by the estimates. An earlier CBO analysis (*Environmental Regulation and Economic Efficiency*, 1985) discusses the various advantages and disadvantages of expenditure estimates versus engineering cost estimates of pollution control. That study also examines the various problems connected with existing expenditure surveys.

4. For example, a CBO hazardous waste analysis (*Hazardous Waste Management: Recent Changes and Policy Alternatives*) estimates annual costs for the primary metals sector of complying with the hazardous waste regulations at around $1 billion. It is unclear whether expenditures for hazardous waste control are included in all the estimates reported here.

have had a negative effect on industry performance. Arthur D. Little, Inc. (ADL), estimated in 1981 that compliance with existing air and water regulations would cost the industry an average of $600 million a year in capital expenditures from 1980 through 1984, and possibly $1.5 billion a year in the 1986-1990 period. 5/ According to the study, these costs would have the following impacts by the year 1990 (assuming full compliance with all current and projected future requirements):

- o Shipments would be 96 million tons in 1990 rather than 105 million tons;
- o Job losses by 1990 would be in the range of 40,000 among workers directly involved in iron and steel production;
- o Steel imports would increase by 1990 to around 42 million tons (compared with 17 million tons in 1979); and
- o All firms with production costs 15 percent to 25 percent over the industry average would be adversely affected (the study did not make an estimate of plant closings).

These results provide a worst-case analysis of what might have happened to the steel industry as a result of environmental regulations if the demand for steel products had increased after 1980 rather than falling off. The study's underlying assumptions as to the future of the industry proved to be far too optimistic. 6/ At the same time, it was too negative in its estimate of the stringency of environmental regulations; it failed to take into account the special regulatory treatment that has been accorded the iron and steel industry in the past, nor did it allow for a learning-curve effect that would tend to lower annual costs. 7/

Actual developments in the early 1980s seem to have overridden the Arthur D. Little framework. Nevertheless, if the ADL estimates are taken

5. Arthur D. Little, Inc., *Environmental Policy for the 1980s: Impact on the American Iron and Steel Industry* (Report to the American Iron and Steel Institute, 1981).

6. For example, ADL assumed that the industry would operate at 90 percent capacity over the relevant period, and increase shipments from 92 million tons to 105 million tons.

7. During the Carter Administration, the steel industry reached at least one agreement with the U.S. Environmental Protection Agency to extend compliance schedules in exchange for increased spending on modernization as part of the Steel Tripartite Committee meetings.

as upper bounds of the potential impact of environmental regulations on an expanding industry, they indicate that the impact would have been significant over the 1984-1990 period. As things turned out, the changes in domestic and international markets for steel appear to have outweighed any effects from environmental regulations. No doubt the environmental regulations may have affected decisions concerning continued operation of some older, high-cost facilities. But downward pressures on employment were also in part the result of shifts from older facilities to new, less labor-intensive plants--more probably a function of increased demand for certain steel products than of environmental costs. (As noted below, however, pollution cost differentials might have the effect of encouraging newer electric arc furnace capacity, which would mean lower overall environmental costs to the industry than those estimated here.) Finally, the ADL estimates were derived from estimates of gross environmental costs, and probably do not reflect tax credits available to the industry and other forms of preferential treatment of pollution control expenditures that lessened their impact.

This qualitative conclusion is supported by simulation results obtained from the CBO iron and steel model. These simulations capture the post-1980 steel downturn. For illustrative purposes, CBO assumes that 12 percent of total capital expenditures (the average reported by McGraw-Hill over the period 1967-1984) were devoted to environmental protection over the period of the model, and that without environmental controls these funds would have been available for "productive" capital investment. The CBO model interprets this as meaning 12 percent more gross investment per year, and makes it available to reinvest over the historical and forecast periods of the model. Although such a simulation is artificial and somewhat contrived, it provides an answer to the question of what might have happened if the iron and steel industry had not had to invest heavily in pollution control plant and equipment over the last 15 years.

The CBO steel model indicates that several effects, or a combination of all of them, would have been likely. First, the extra capital might have spurred additional investment in steelmaking capacity, even in the face of declining demand. The result, of course, would have been even further declines in capacity utilization. Second, the additional funds might have been returned to investors in the form of dividends as after-tax profits rose. Finally, increased investment in labor-displacing technology might have accelerated employment losses in the industry. The actual outcome, of course, would depend on how the increased capital was distributed in the industry. (The CBO model assumes that the capital would be available to both integrated and minimill producers.) 8/

8. See Appendix B for details.

The CBO simulations should be viewed as illustrative rather than demonstrative. Nevertheless, they are consistent with an iron and steel market that is constrained by falling demand. Essentially, the simulations highlight the fact that a larger pool of capital, whether from fewer environmental regulations or from some other source, would not likely have led to significant differences in the industry's performance in the face of rapidly declining markets. The CBO analysis does not suggest that environmental regulations have been costless to the steel industry. Rather, it argues that the available evidence does not support the contention that the costs of environmental regulations have contributed significantly to the industry's current difficulties.

The foregoing discussion has treated the steel industry as homogeneous, ignoring the way in which pollution control costs are actually distributed among different sectors of the industry. The minimills tend to be substantially less effluent-intensive than the integrated steel works, and so it would be reasonable to presume that capital costs for pollution control are a substantially smaller percentage of overall costs in the minimill sector. Plausibly, this might give minimills a competitive advantage in the industry and lead to their more rapid increase. The available data do not provide a firm basis for testing this hypothesis, but the high level of expenditures on environmental control in the industry suggests that cost differentials could be large if the sectors of the industry are characterized by very different levels of pollution problems.

International Competitiveness

It is often argued that mandatory environmental expenditures have placed the U.S. iron and steel industry at a competitive disadvantage relative to foreign producers. This follows from the assumption that major foreign producers do not face the same level and stringency of environmental controls. There is reason to question the assumption. Studies in the last five years have found that most foreign producers of iron and steel face similar, and in some cases higher, environmental protection costs. For example, the average pollution control investment per ton of steel in the period 1973 to 1980 was $4.06 for the United States and $4.52 for Japan. A CBO analysis of total environmental expenditures in several countries reveals little difference in the nature or scope of environmental controls in West Germany, Canada, or Japan. [9] Price differentials between domestic and foreign steel

9. Congressional Budget Office, *Environmental Regulation and Economic Efficiency* (March 1985).

are thus more likely to represent differences in other costs than those of environmental regulation. In some countries, however, the impact of similar environmental expenditures may be less than in the United States where the regulatory programs tend to be more restrictive and possibly less cost-effective.

It is worth noting that comparisons of environmental controls in steel-producing countries tend to focus on the more developed countries. Their conclusions may not hold for steel produced in less developed countries such as Korea or Mexico, where pollution control may seem less urgent than the need for foreign exchange. Thus, it is possible that steel produced in these countries enjoys a cost advantage over U.S. steel because of fewer environmental controls as well as because of lower labor costs and more efficient plants.

REGULATION IN THE FUTURE

This chapter has presented a retrospective look at the relationship between environmental regulation and the current status of the iron and steel industry. Of greater importance from a policy point of view is the outlook for environmental regulation in the future, and whether events looming on the horizon may lead to an efficient restructuring of the steel industry. No easy answers are at hand, but it is possible to draw certain conclusions about the future role of environmental regulation in steel that may serve as a basis for evaluating alternative policies.

First, it is important to recognize that the steel industry has already made the bulk of its financial commitment to most of the known pollution problems, although it will continue to face annual operating and maintenance expenses associated with air and water programs. Depending on the outcome of current revisions in the National Ambient Air Quality Standard for particulates (the major air pollutant in steelmaking), few additional air requirements of substantial magnitude seem likely. Major revisions in this standard could, however, lead to significant costs. Similarly, new water pollution control requirements seem unlikely unless the Environmental Protection Agency adopts a stringent program to address toxic hot spots (areas where the best available technology is not able to meet water quality standards).

The biggest uncertainties arise from efforts to regulate hazardous and solid waste disposal. Current hazardous waste rules identify several steel by-products as hazardous (such as pickle liquor, electric arc furnace dust, and coal tar wastes) and therefore subject to the increasingly stringent Resource Recovery and Conservation Act (RCRA) Subtitle C requirements. The major steel waste by-product, slag, is classifed as a solid waste (if it results from steelmaking activities) or is currently exempt from regulation (if it results from blast furnace operation). Regulatory programs under RCRA involving hazardous and solid wastes are in a state of flux, however. Depending on the outcome of pending regulatory decisions concerning matters such as the classification of slag as a solid or hazardous waste, requirements for operation of solid waste units, and the definition of a disposal unit for corrective action purposes, RCRA programs could have major financial implications for the industry. Estimates of the potential costs are highly uncertain at this time.

As already indicated, the burden of environmental control expenditures is likely to fall most heavily on the integrated sector of the industry. To the extent that minimill penetration continues, environmental expenditures in the industry will probably decrease in comparison to their historical levels regardless of the final RCRA rules for iron and steel wastes. Assuming that no new environmental problems are found, the impact of environmental control costs on the steel industry will be increasingly marginal and relate mainly to integrated facilities.

CHAPTER VI

IMPLICATIONS FOR POLICY

The decline of the integrated sector of the steel industry has given rise to Congressional concern that capital formation in the industry is inadequate.[1] This paper has examined the interactions between capital formation in steel and various aspects of federal policy--including tax, trade, antitrust, environmental, and science policy. It has consistently found that federal policies have not been a significant deterrent to steel industry investment. In fact, many aspects of federal policy--most notably, a series of trade restraints--may have promoted investment.

Another consistent result of this analysis is that the current low levels of investment--or *disinvestment*--in the integrated sector of the steel industry are more a symptom of that sector's decline than a cause of it. Simulations with the CBO steel model indicate that greater levels of investment in the recent past would not have led to major changes, particularly in employment and output. Nor would they in the near future. In Chapter V, for example, the steel model was used to simulate the industry's recent past under the assumption that expenditures on new plant and equipment were substituted for capital expenditures on pollution abatement equipment from 1974 to the present. The resulting increase in output, as measured by the model, was negligible. Similarly, in Chapter IV, results were reported suggesting that the effects of the "reinvestment" provisions of the Trade and Tariff Act of 1984 (Public Law 98-573) are likely to have a small effect on the steel industry's performance, particularly when compared with the effects of the accompanying quotas themselves.

The small effect of higher levels of investment on the performance of the steel industry can be explained by the primary sources of the industry's decline: falling steel consumption per unit of gross national product, cost disadvantages in labor and raw materials, and inhospitable economic conditions--most notably, an exchange rate that has penalized U.S. manufacturers. Higher levels of capital formation in the steel industry would not expand the market for steel, nor make U.S. labor, ore, or energy cheaper,

1. See, for example, House Committee on Science and Technology, *New Technology and the Future of Steel* (June 1986).

nor countervail the competitive advantage enjoyed by such producers as Korea, Taiwan, and Mexico as a result of high dollar exchange rates. Neither will increased capital formation improve employment in the steel industry, since investment in new equipment tends to be labor displacing.

The finding that increased capital formation would not of itself qualitatively change the prospects for the domestic steel industry is consistent with the belief that capital markets tend to allocate funds efficiently among industries. The low level of investment in the domestic steel industry (including pronounced disinvestment in the integrated sector) reflects the low rates of return such investments offer. As noted by one steel executive:

> Reduced demand for our products makes investment less attractive to outside investors because the meager profits simply are not attractive enough to repay the investors in a reasonable time. Also, borrowing for investment becomes more difficult, more expensive, because lenders perceive lending to a poorly performing company, understandably, as high risk. 2/

If capital markets are correct in seeing investment in the steel industry (most notably, the integrated sector) as an inefficient use of scarce resources, then any federal effort to stimulate such investment would be at the expense of other, more valuable economic activities. For that reason, other ways of assisting the steel industry may be preferable. Among these are:

- Spurring research and development to bring about innovation;
- Providing incentives to restructure the industry; and
- Smoothing the transition to a smaller industry.

RESEARCH AND DEVELOPMENT

Previous CBO studies have discussed the rationale for federal funding of research and development. 3/ The most important argument is that private incentives to increase R&D are limited; the returns to scientific discoveries

2. Op. cit., p. 15.

3. See Congressional Budget Office, *Federal Support for R&D and Innovation* (April 1984) and *Federal Financial Support for High-Technology Industries* (June 1985).

cannot be fully appropriated by the innovator, since imitators can use the discovery to their own ends. But the rate of return to R&D in general is high, and the social rate of return is higher than that realized by the innovator. 4/

A variety of federal initiatives already exist (see Chapter III) that address the technological problems found in the steel industry. In 1985, the Committee on Science and Technology proposed federal funds for the creation of industrywide research facilities that would allow the major steel firms to work collectively on a range of advanced research problems, among them direct reduction of iron ore, refractory wear, and cleansing of particulates and sulfur from gases. The major steel firms have a common interest in producing such innovations, but may hesitate to fund them because of the appropriability problem mentioned above and because of the firms' poor cash flow. Centralizing these efforts would also avoid duplication in research efforts. Once the usefulness of any innovation was proved, firms would use their own resources to build pilot plants for commercial demonstration.

Given the poor financial condition of most major integrated steel producers, there may be technological opportunities that can be explored only by a joint public-private undertaking. Such a program, however, raises questions of *time*, of *management*, and of *coordination*.

Time

The innovations produced by a steel industry research center would probably require lead times of a decade. Laboratory and demonstration facilities would have to be built, pilot plants constructed, and the capital stock of the steel industry changed to incorporate the innovation. But many integrated steel producers are in immediate financial jeopardy, and major innovations 10 years hence can do little to change their current situation.

Management

An industrywide research facility also poses difficult management issues. First, the decision to create such a facility, primarily aimed at integrated steel producers, presupposes that this would be the most productive way of modernizing the industry. But a research agenda aimed, for example, at

4. See Congressional Budget Office, *Federal Support for R&D and Innovation* (April 1984), pp. 29-30.

broadening the range of products that could be produced by minimills might offer more valuable results than one aimed at innovation in the integrated sector. A second issue is that of access to the products of such a research facility. Limiting access might be detrimental to competition in the industry in the long term. Yet, unlimited dissemination of research results would leave individual firms with little incentive to participate in the funding and operation of the facility. Moreover, a number of U.S. firms have recently formed relationships with foreign steel interests. If innovations produced by a government-funded facility were shared with foreign firms, this would exacerbate the problems of the domestic industry.

Coordination

If a national public-private research facility was set up, it would probably be superimposed over the diverse steel-related R&D activities already existing in the federal government and in private industry. Research would have to be coordinated to avoid duplication of existing efforts. Perhaps a panel of government and industry representatives and outside experts could develop a publicly-assisted research agenda. Such a panel might make the government a more credible partner in the steel R&D effort, and give steel firms more incentive to participate in joint R&D ventures with the federal government. But at the same time, it might choke off potentially profitable private research and raise mangement issues similar to those discussed above.

EFFORTS TO RESTRUCTURE THE STEEL INDUSTRY

Massive overcapacity is a severe impediment to technological innovation and new investment in the steel industry. If the market for steel products should improve in the future, firms with old facilities that are now not in service might be tempted to operate them at marginal cost despite the fact that they are not profitable. This overhang of capacity thus acts to lower future prices, and may be a severe disincentive to new investment in the steel industry.

Despite the fact that these facilities are unprofitable on their own merits, steel firms may be reluctant to retire them. For one thing, if a firm retires capacity before its competitors do, it may be ceding a share of the market to them should conditions improve. Moreover, as shown in Chapter IV, the costs of retiring facilities may be very large, including the engineering "shut-down" costs of scrapping or mothballing a facility, payments to labor (particularly for retirement benefits), and ongoing costs of long term supplier contracts for raw materials that cannot be abrogated simply because of plant closures. Finally, closing facilities may place some producers in technical bankruptcy because of covenants on outstanding loans.

A cabinet-level Interagency Working Group chaired by the Secretary of Commerce is now investigating how federal policies may affect the decision of steel companies to retire antiquated facilities. A report from this group, expected in the first half of 1987, will shed greater light on options for bringing about prompter retirement of obsolescent steelmaking facilities. Among these options are: waiving antitrust restrictions to allow greater consolidation among existing steel firms; changing the tax treatment of the write-offs associated with plant retirements; assuming all or part of the pension burden associated with plant closings; or developing an explicit sectoral policy toward the steel industry in which these forms of assistance would be exchanged for participation by the involved firms in worker retraining and relocation, or in steelmaking research and development, or in the establishment of new facilities embodying technological advances. The interests of firms in different positions within the steel industry may converge on this issue. Stronger firms may welcome the exit of weaker firms if their capacity is permanently withdrawn from the market, while weaker firms may accept federal assistance in meeting the costs associated with their exit.

MANAGING THE TRANSITION TO A SMALLER INDUSTRY

If most projections, including those of the CBO steel model, are correct, the steel industry, notably the integrated sector, will be smaller in the future than it is today. The costs of this shrinkage to the federal government are likely to be quite high. On one side will be the loss of interim tax revenues from unprofitable firms and out-of-work employees. On the other will be increased federal outlays for unemployment benefits, food stamps, and other social services. Additional bankruptcies in the steel industry would also put the Pension Benefits Guaranty Corporation under severe financial stress, forcing it to call upon the Treasury for federal assistance.

One way of handling these costs would be to pay for them as they arise. Since many of them are directly related to the slowness of unemployed resources to find alternative employment, they would be minimized if the shrinkage took place in a growing economy. Under ideal conditions, capital and labor from the steel industry would move into other industries, and their unemployment would be transitory.

But the inevitable contraction may occur in regions already burdened by relatively high unemployment. In that case, the costs to the federal government of the transition to a smaller steel industry could be minimized by some forward design. One option would be to focus federal policy on workers who had been displaced. 5/ The government could use its resources to set up a relocation and retraining program for such workers. The principle of providing some type of assistance to displaced workers has been part of U.S. trade law since the Trade Adjustment Assistance (TAA) program was enacted in 1962, and is also recognized in the Job Training Partnership Act of 1982 (JTPA). The TAA program, however, emphasized cash assistance rather than retraining; only 1.4 percent of workers participating in TAA undertook and completed a retraining program, and of those only about one-third took jobs for which they had been trained. The TAA program is authorized at $29.9 million for fiscal year 1987. Title III of the JTPA also funds some training for dislocated workers. In fiscal year 1987, $200 million, or about 5 percent, of JTPA's $3.7 billion budget is authorized for this purpose. The Administration's 1988 budget proposal would combine TAA and JTPA programs into a single program to aid all dislocated workers, budgeted at $986 million in the first year.

If the federal government participated in a joint government-industry agreement to retire excess steel capacity, retraining funds could be targeted to those facilities closed under the agreement. Job retraining could be emphasized in the program design, or made mandatory as a condition for unemployment insurance payments.

Proponents of retraining programs note that the retraining of workers increases the mobility of economic resources, promoting economic change and long-term economic growth. Critics, on the other hand, note that job displacement occurs continually throughout the economy as a result of changes in tastes, economic conditions, trade, and a variety of other factors; a special retraining policy for one set of workers is therefore seen as arbitrary and inequitable.

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5. See Congressional Budget Office, *Has Trade Protection Revitalized Domestic Industries?* (November 1986) and *Dislocated Workers: Issues and Federal Options* (July 1982).

APPENDIXES

APPENDIX A

DESCRIPTION OF THE CONGRESSIONAL BUDGET OFFICE STEEL MODEL: A SMALL-SYSTEMS MODEL

The CBO model of the U.S. steel industry is a partial equilibrium econometric model, specifically designed, estimated, and simulated to address the concerns in this study. The three subsectors of the industry, the integrated, speciality, and minimill sectors are combined for modeling purposes. 1/ The model includes 15 stochastic equations and 10 identities. Estimates of the coefficients are obtained using national time series data (1965-1985). The 25 endogenous (solution) variables in this system of equations are:

- Import price of steel;
- Domestic price of steel;
- Imports of steel;
- Exports of domestic steel;
- Domestic production of steel;
- Domestic capacity;
- Domestic shipments;
- Demand for domestically produced steel;
- Domestic capacity utilization;
- Domestic average operating costs;
- Domestic total operating costs;
- Domestic markup;
- Domestic capital costs;
- Domestic capital stock;
- Domestic gross investment;
- Domestic net investment;
- Domestic employment;
- Domestic share of production, electric arc furnaces;
- Domestic steel revenue;
- Domestic after-tax profits;
- Domestic before-tax profits;
- Apparent domestic consumption;

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1. This model is a revision and extension of work done for an earlier CBO study, *The Effects of Import Quotas on the Steel Industry* (July 1984). The later version explicitly incorporates an investment function to assess better how an increase in near-term profits would affect capital formation and the competitive position of the industry.

- o Import share of consumption;
- o Imports of Japanese steel;
- o Japanese share of imports.

Estimation and Simulation

The model provides a representation of how the domestic steel and imported steel markets might perform over the historical (1973-1985) and forecast periods (1986-1992) under a variety of different assumptions. The model is, of course, subject to the same limitations as any econometric model, and depends critically on the data used to obtain coefficient estimates. 2/ The present model is only a generalization or abstraction of the forces that affect the industry. Yet the model provides a consistent way to ask "what if" questions pertinent to this analysis.

Model simulations consist of solving the system of equations for each relevant time period, given the coefficient estimates and values of exogenous variables, so as to provide assessments of how various policies or changes in exogenous variables may affect the industry. The values of the exogenous variables for the 1986-1992 period are based on CBO's medium-term economic projections.

Market Characterization: Domestic and Imported Steel as Imperfect Substitutes

The CBO model follows the convention of treating the markets for imported and domestically produced steel separately. 3/ This market representation depicts domestic and imported steel as imperfect substitutes with relatively large cross-price effects.

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2. All econometric models are at best different ways of organizing and presenting data. In this one, the simulation results depend on coefficient estimates obtained from national time series data. Several estimators were used to analyze the sample data. For example, single-, two-, and three-stage least squares estimators were used, in combination with an auto-correlation correction, to obtain sets of coefficient estimates. These were subjected to extensive structural analysis to determine which set of coefficients provided the most stable and "reasonable" dynamic multipliers within and outside the sample.

3. See Robert Crandall, *The U.S. Steel Industry in Recurrent Crisis* (Washington, D.C.: The Brookings Institution, 1981), p. 130, and the Federal Trade Commission, "Prehearing Brief for Carbon and Certain Alloy Steel Products, Investigation No. TA-201-51 before the International Trade Commission" (May 1984), Appendix A, p. 7.

For example, a decrease in the import price resulting from an appreciation in U.S. currency elicits a reduction in the demand for domestic steel and an increase in the demand for imports and in the import share of apparent domestic consumption. This assumes no change in the outputs of steel-using industries such as automobiles, construction, oil and gas exploration, and so forth.

Import Supply

The import supply curve is perfectly elastic; import prices are represented as a function of foreign capacity utilization, a three-year distributed lag of exchange rates, foreign operating costs per ton, and time. The demand for imports is a function of import prices, domestic prices, dummy variables, and output indexes of steel-using goods. The Japanese share of imports appears as a function of the exchange rate for major trading partners, the Japanese exchange rate, and a dummy variable representing periods of voluntary trade restraints (1969-1972, 1979-1982, and 1985).

Domestic Supply

The domestic supply function is a composite function, consisting of a markup function and an average variable cost function. The use of the composite function permits the possibility of oligopolistic market reactions, without ruling out marginal cost pricing.

Increases in capital stock and the additional penetration of electric arc furnaces (minimills) occur as investment increases. Each is determined by after-tax profits and rental rates of capital. As capital stock and additional penetration of electric arc furnaces increase, reductions occur in average variable costs, resulting in greater industrywide profit margins. Domestic production, capacity, and supply increase in subsequent periods as a result of investment in a previous period. Average variable cost, the difference between domestic price and markup per unit capital costs, is also expressed as a function of domestic supply, wage rates, the price of scrap, and the prices of coal and iron ore. The underlying production technology exhibits variable returns to scale. Profits, total variable costs, capital costs, capacity utilization, exports, revenues, after-tax profits, and import share obtain as identities.

Domestic and Import Demand

The demands for imported and domestic steel appear as functions of domestic and imported prices, output indexes of steel-using products, notably automobile production and real fixed investment, and various dummy variables. When the quotas become binding during the simulations, the short-run equilibrium import price becomes an inverse function of the import demand. Domestic demand adjusts accordingly.

APPENDIX B

RESULTS OF POLICY SIMULATIONS

In this analysis, the CBO steel model was used to depict industry outcomes under a variety of assumptions. As with any econometric model, the CBO steel model is at best an approximation of the industry's responses to different situations, and its estimates of future outcomes are based on extrapolations of past behavior. 1/ Given these limitations, the model does provide a set of internally consistent estimates of how various factors affect the steel industry. This appendix presents results generated by the model; the results support the statements made in the report.

Table B-1 presents the effects of limiting steel industry imports to 23 percent or 20 percent of the U.S. market over the 1986-1992 period.

Table B-2 presents the effects of refunding the investment tax credit to the steel industry, under the Tax Reform Act of 1986.

Table B-3 presents the effects of eliminating steel industry pollution-abating capital expenditures and replacing them with expenditures on new plant and equipment directly related to steel production.

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1. See Appendix A for details of the model.

TABLE B-1. EFFECTS OF QUOTAS ON THE STEEL INDUSTRY

Industry Outcomes	Actual 1985	1986	1987	1988	1989	1990	1991	1992
U.S. Shipments (In millions of tons)								
Base case	72.7	69.3	73.3	74.6	73.8	72.2	70.5	68.7
23% quota	72.7	72.5	72.7	72.9	73.9	74.6	75.0	75.4
20% quota	72.7	75.3	75.9	76.1	77.2	77.9	78.3	78.7
Import Share (In percent)								
Base case	25.3	26.4	22.0	21.3	23.4	25.4	27.3	29.3
23% quota	25.3	23.0	23.0	23.0	23.0	23.0	23.0	23.0
20% quota	25.3	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Domestic Steel Employment (In thousands)								
Base case	155.2	144.6	145.0	144.9	137.4	126.1	113.4	100.2
23% quota	155.2	151.1	146.3	140.4	135.8	130.7	124.1	116.5
20% quota	155.2	156.8	154.7	148.7	143.5	137.7	130.4	122.2
Gross Domestic Investment (In billions of 1972 dollars)								
Base case	2.8	2.5	2.5	2.6	2.7	2.8	2.9	2.9
23% quota	2.8	2.5	2.6	2.6	2.7	2.8	2.9	3.1
20% quota	2.8	2.6	2.6	2.7	2.9	3.0	3.1	3.3

SOURCE: Congressional Budget Office steel model.

TABLE B-2. EFFECTS OF INVESTMENT TAX CREDIT REFUNDING ON OUTPUT, EMPLOYMENT, AND INVESTMENT IN STEEL

Industry Outcomes	Actual 1985	1986	1987	1988	1989	1990	1991	1992
Total U.S. Shipments (In millions of tons)								
Base case	72.7	69.3	73.3	74.6	73.8	72.2	70.5	68.7
1988 tax refund	72.7	69.3	73.3	74.6	73.9	72.4	70.6	68.8
Domestic Consumption (In millions of tons)								
Base case	96.1	93.0	92.0	93.0	94.4	95.3	95.8	96.2
1988 tax refund	96.1	93.0	92.0	93.0	94.4	95.3	95.8	96.2
Import Share of Consumption (In percent)								
Base case	25.3	26.4	22.0	21.3	23.4	25.4	27.3	29.3
1988 tax refund	25.3	26.4	22.0	21.3	23.4	25.4	27.3	29.3
Domestic Steel Employment (In thousands of dollars)								
Base case	155.2	144.6	145.0	144.9	137.4	126.1	113.4	100.2
1988 tax refund	155.2	144.6	145.0	144.9	137.4	125.8	113.1	99.9
Capital Stock (In billions of 1972 dollars)								
Base case	14.8	14.8	14.2	14.0	13.8	13.6	13.4	13.2
1988 tax refund	14.8	14.8	14.2	14.0	14.0	14.0	13.4	13.2
Gross Domestic Investment (In billions of 1972 dollars)								
Base case	2.8	2.5	2.5	2.6	2.7	2.8	2.9	2.9
1988 tax refund	2.8	2.5	2.5	2.6	2.7	2.8	2.9	3.0

SOURCE: Congressional Budget Office steel model.

TABLE B-3. IMPACT OF REDUCED ENVIRONMENTAL CAPITAL EXPENDITURES ON THE IRON AND STEEL INDUSTRY

Industry Outcomes	1985	1986	1987	1988	1989	1990	1991	1992
Capital Stock (Quantity index)								
Base case a/	15.4	14.8	14.2	14.0	13.7	13.6	13.4	13.2
Policy b/	19.6	19.4	19.2	19.3	19.5	19.7	20.0	20.1
Production Capacity (In millions of tons)								
Base case	139.7	135.1	130.7	129.2	128.8	128.6	128.4	127.9
Policy	142.3	138.2	134.5	133.7	134.1	134.9	135.5	136.0
Capacity Utilization (In percent)								
Base case	64.7	64.0	69.2	71.0	70.3	68.9	67.3	65.7
Policy	64.2	63.4	68.3	69.8	68.9	67.3	65.5	63.7
After-Tax Profits (In millions of 1972 dollars)								
Base case	-570	-480	460	880	950	910	840	770
Policy	-360	-260	710	1,170	1,260	1,230	1,180	1,110
Domestic Prices (In dollars per ton)								
Base case	250.6	250.3	251.4	251.8	251.7	251.5	251.2	250.9
Policy	249.3	249.0	250.0	250.2	250.0	250.0	249.2	249.0

SOURCE: Congressional Budget Office steel model.

a. All reported results are simulated by the CBO steel model.

b. Capital expenditures for environmental protection over the 1967-1984 period are assumed to be available for "productive" investments.