UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

20591

INTERNATIONAL TRADE IN STEEL[1]

1. Historical Background of Trade Policies

During the early post-WWII period there was concern that the US steel industry did not have sufficient capacity to accommodate the increasing domestic and export demands for steel. The oligopolistic structure of producers and highly unionize labor led to a series of liberal wage increases accompanied by even higher price increases. The decade of 1947-57 witnessed annual wage and price increases of 6.6% and 7%, respectively. In contrast, manufacturing wages in the US increased by 5.2% and wholesales prices by only 2% annually.

By the middle 1950s, Western Europe and the USSR had recovered their steel making capacity. Together the United States and these producers accounted for almost 70% of world output. This recovery brought unexpected and severe competition to the U.S. industry. U.S. imports increased to the point that by 1971 imports captured 18% of U.S. consumption. And even though world exports grew by almost 9% annually, U.S. exports declined from 11% of world exports in 1956 to 2% of world exports in 1971.

---

[1]This chapter will emphasize trade among market oriented countries. Owing to the very uncertain events impacting on Central and Eastern Europe (including territory of the former USSR) and China, these countries will not be treated in detail.

Japan was also emerging as an important competitor. Exports increased from a very low volume in 1956 to account for almost 20% of the world's exports by 1971. Japan acquired some very important competitive advantages. First, their wage structure was low. And over time as wages increased productivity increased even more so that labor costs actually declined. Second, they installed the most modern capacity to assure high quality low cost output. Since efficient plants and economies of scale would create output levels that exceed domestic demand, the need to export was recognized from the beginning. Third, Japan cited factories at coastal locations to lower the cost of shipping raw materials; ocean freight rates were declining owing to larger vessels. Even though input materials were shipped from as far as Australia and Brazil, ocean shipping rates were lower than the overland rates being paid by U.S. producers.

By the late 1950s the U.S. industry had sufficient capacity to meet demands over the next two decades. U.S. consumption of steel did increase during this period but by less than 1.5% annually. And the demand shock of the middle 1960s, owing to the Vietnam war, was satisfied by importing. Throughout this period, the U.S. industry was increasingly pressured by import competition at very competitive prices. Moreover, the U.S. government opposed the industry practice of excessive wage increases followed by even higher steel price increases. In 1962 President Kennedy forced the industry to rescind a price increase. In the late 1960s, prices increased in response to the high level of demand owing to the Vietnam war; in 1968 President Johnson jawboned the industry into rolling back these price increases as well.

During 1968, U.S. imports increased by more than 50% to 18 million net tons. Pressures from industry resulted in the negotiation of VRA's with suppliers from the EC and Japan; the VRAs limited imports to 14 million net tons. The strong demand for steel in the U.S. during 1973-74 made the VRAs unnecessary; they were terminated during 1974.

However, by 1977 the world market faced excess supply. This excess supply hit European supplies especially hard in their home markets and their exports to neighboring markets. Prices declined substantially in Europe. Exports were being diverted to the U.S. and prices fell there as well. Some U.S. plants were idled, others closed. The resulting job losses became of serious concern to Congress where a steel caucus of some 200 members was formed; the Carter Administration was attentive.

The Administration first considered using the antidumping provision of the Trade Act of 1974 as a means to buttress U.S. prices. The 1974 Act contained a new definition of dumping, namely, imports a prices below the cost of production. The previous definition was based on a comparison between home country prices and export prices, i.e., dumping occurred if export prices were lower than home sales prices. Thus, if a European exporter charged the same price on sales in the home market as on sales to the U.S., no dumping existed, and the U.S.

could not introduce an antidumping duty. During this period, prices in both the European and U.S. markets were depressed. But under the new Act, European sales in the home market, being at prices below the cost of production, were not to be considered. If sales in the U.S. market occurred at prices below costs, antidumping duties could be introduced.

However, this policy contained an important oversight. Japan was also the source of significant volumes of U.S. imports and Japan had significant excess capacity. Moreover, Japan was the world's most efficient producer and was selling in the U.S. market at prices above cost, i.e., Japan was not dumping. The use of the antidumping provision would curtail U.S. imports from Europe; but those imports would surely be replaced by imports from Japan. The effect of this policy would simply be to alter the source of U.S. imports, not the volume. U.S. producers would gain little if any relief and European producers would be seriously harmed -- with serious adverse implications for U.S. - European political relations.

As a result an alternative policy was sought. The result was the so-called Trigger Price Mechanism (TPM) which was introduced in 1978. Under this policy the Administration would publish minimum prices for steel imports. Imports at prices above the TPM prices would be permitted; imports at prices below the TPM price would immediately initiate an expedited antidumping proceeding with the expected outcome being the introduction of an antidumping order against future imports from that supplier. The published TPM prices were calculated on the basis of Japanese costs of production (assuming an 85% rate of capacity utilization). The effect of this policy was to raise steel prices in the U.S. market, initially by an average of 6%. Importantly, European exporters could continue to supply their U.S. customers provided they complied with the TPM price guidelines.

At the same time Commissioner Etienne Davignon of the European Commission was preparing a reference price system for the EC (the so-called Davignon Plan). Under this program there were a set of domestic reference prices, import reference prices, and a phased reduction of steelmaking capacity.

In addition, Japan exercised restraint in exporting to the U.S. and European markets. The result of the TPM, the Davignon Plan and Japan's export restraints was a firming of steel prices and an informal control of important world steel markets.

However, the significance of excess capacity did not go away. Prices remained too low for producers to recover costs. Some firms attempted to reduce average costs by operating at high levels of capacity utilization and practicing severe price competition. The Davignon Plan failed to maintain high prices in Europe. And the TPM failed to satisfy the U.S. industry. In early 1980, a number of antidumping actions were initiated against producers in five European countries. As a result the TPM was terminated in March 1980. However, the U.S. industry withdrew the antidumping petitions with the result that the TPM was reinstituted in October 1980. Japan continued to restrain exports to the United States. Consequently, U.S. imports from Japan remained stable.

In January of 1984 the Bethlehem Steel Corporation and the United Steelworkers of American (a labor union) jointly filed a petition with the U.S. International Trade Commission (USITC) under section 201 of the Trade Act of 1974 seeking relief from increased imports of carbon steel.[2] This investigation resulted in a determination by the USITC that imports cause material injury to the domestic industry; the USITC also provided the President with a recommendation regarding appropriate import relief policies.

The President determined that the remedy recommended by the USITC was not in the national interest of the United States and instead directed the U.S. Trade Representative (USTR) to negotiate voluntary restraint agreements (VRAs) to cover the 5-year period 1 October 1984 through 30 September 1989. Subsequent to this decision the USTR negotiated VRAs with 20 trading partners: Australia, Austria, Brazil, Czechoslovakia, East Germany, the European Communities (EC), Finland, Hungary, Japan, Korea, Mexico, China, Poland, Portugal, Romania, South Africa, Spain, Trinidad and Tobago, Venezuela and Yugoslavia.

A part of the political leverage which U.S. industry representatives brought to the negotiating table were a number of

---

[2]This is the so-called GATT escape clause provision of U.S. trade law.

pending unfair trade cases alleging that imported steel was being dumped or was benefiting from government subsidies. Foreign governments insisted that the VRAs include a withdrawal of pending cases and a suspension of existing antidumping and countervailing duties. All was agreed. The VRAs were signed. And U.S. imports of carbon steel products were to be limited to 18.5 percent of the U.S. market. Though these agreements did not initially did not cover semifinished steel products, such products were covered by subsequent agreements limiting U.S. imports of these products to 1.7 million tons per year.

On 25 July 1989 President Bush announced that the Steel Trade Liberalization Program, under which the VRAs were to be extended for two and one-half years, would be terminated 31 March 1992. The program was not extended beyond that date; U.S. markets are no longer protected by VRAs.

Owing to weak demand for steel in the world market and continuing imports of steel benefiting from government subsidies, 12 steel producing firms in the United States filed petitions with the appropriate authorities in the United States (the Department of Commerce and the U.S. International Trade Commission) initiating antidumping and antisubsidy proceedings against 21 countries: seven EC countries, three EFTA countries, two former CPE countries, four non-European developed countries and five developing countries.[3] The proceedings covered four

[3]The countries are: Argentina, Australia, Austria, Belgium, Brazil, Canada, Finland, France, Germany, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Poland, Romania, Spain, Sweden,

major flat-rolled steel products: plate, hot-rolled sheet, cold-rolled sheet, and corrosion-resistant sheet; these products account for roughly one-half of all of the steel produced in the United States.

These proceedings were concluded in August 1993 with the following outcomes. For plate, antidumping and countervailing duties were imposed on imports from Belgium, Brazil, Germany, Mexico, Spain, Sweden and the United Kingdom; in addition, antidumping duties were imposed on imports from Canada, Finland, Poland and Romania; all other cases were terminated in the negative. For hot rolled steel sheet all cases were terminated in the negative; no antidumping or countervailing duties were imposed. For cold rolled steel sheet, antidumping and countervailing duties were imposed on imports from Germany and Korea; in addition, antidumping duties were imposed on imports from the Netherlands; all other cases were terminated in the negative. For corrosion-resistant products antidumping and countervailing duties were imposed on imports from France, Germany and Korea; in addition antidumping duties were imposed on imports from Australia, Canada and Japan; all other cases were terminated in the negative. The total value of imports covered by affirmative determinations was roughly equal to the total value of imports covered by negative determinations.

Taiwan, and United Kingdom.

2. The Global Steel Industry

Production facilities: The carbon steel industry includes production from four different types of facilities, namely integrated mills, minimills, specialty steel mills and converters or processors. The first three actually produce molten steel while the fourth processes crude steel purchased from one of the first three. These facilities are briefly described in turn.

Integrated mills are large capital-intensive facilities that produce steel from natural raw materials, mainly iron ore, coal and limestone. Nearly 75 percent of the world's steel is produced in integrated mills. Annual capacity of an integrated mill ranges from 1 to 10 million tons.

Minimills produce steel by melting scrap in electric arc furnaces. Investment and operating costs are much lower for minimills than for integrated mills. Owing to the problem that scrap raw materials contain numerous impurities, minimills typically produce merchant grade carbon steel products such as bars, rods, rails and light structural shapes. More recently, technological innovations have increased the range and quality of minimill products. However, to date minimills cannot produce high quality sheet products such as corrosion resistant sheets for automobile body panels. Annual capacity of a minimill is generally less than 1 million tons.

Specialty mills, like minimills, produce steel by melting scrap in electric arc furnaces. Stainless and alloy steels are made by adding alloys such as chromium, nickel and molybdenum to impart special properties to the finished steel. Annual capacity of specialty mills is much smaller than integrated mills.

Converters do not produce molten steel. They process slabs, blooms and billets purchased from crude steel producers. Typical output products would include plate, hot and cold rolled sheet, structural shapes and so forth. In addition they produce coated products such as corrosion resistant (e.g., galvanized) sheet.

Downstream users of steel: The primary downstream users of steel products include the following steel-using industries: automobile, metal stamping, construction, household appliances, forging, machinery and equipment, shipbuilding, containers, and the oil and gas industry.

The automobile industry is the largest steel using industry; it directly accounts for about 15% of US apparent consumption of steel. Total steel usage is significantly larger since the automobile industry is also a significant customer of the metal stamping and forging industries (see below). Steel accounts for 5-6% of an average car's sales price.

The metal stamping industry accounts for 25% of US apparent consumption of steel, half of which is ultimately destined for use in the automobile industry. Steel accounts for between 30 and 60 percent of cost. Metal stamping is the process of giving shape and utility to hot-rolled, cold-rolled, and stainless sheet by cutting, piercing, and forming it in presses.

The construction industry accounts for 10-15% of US apparent consumption of steel, including 6% used in structural steel applications. The fabricated structural steel industry uses structural shapes and plate steel to construct load-bearing structures of buildings and bridges. Steel represents 50-60% of contract costs. However, the construction of a completed project will use many other contractors as well; thus, the cost share of steel in a complete construction project will be much lower and will vary significantly from project to project.

The household appliances industry accounts for 2% of US apparent consumption of steel. Steel accounts for 10% of total costs in the industry.

The forging industry accounts for 1-2% of US apparent consumption of steel. Steel accounts for 20-30% of production costs. The forging industry shapes, refines and improves the mechanical properties of metals by subjecting them to impact or pressure. The output products vary significantly in size and weight, ranging from small industrial fasteners and non-powered hand tools to much larger locomotive crankshafts and rotor shafts for power generating equipment which may weight one ton or more. The small to medium sized low value products are destined primarily for the automobile, construction, agriculture and manufacturing industries; large low valued products are used in shipbuilding, petroleum exploration, railroad, and heavy industrial manufacturing. The aerospace and power generating industries use relatively high valued forged products.

The machinery and equipment industries (including agricultural and construction equipment) account for 1% of US apparent steel consumption. The cost share of steel in these industries ranges from 12% to 24%.

World production: Summary data for world production and consumption of steel are presented in Table 1. These data divide the world into three primary country groups: market-oriented industrial countries, market-oriented developing countries, and centrally-planned countries (CPEs). This division is historical and takes on less meaning today as many of the formerly centrally-planned countries are in the process of transformation toward more market-oriented economies. Notwithstanding these events, the state of the world steel industry today is the result of past history. The state of the world steel industry tomorrow will be influenced by this process of transformation, with all of the uncertainly inherent in the process.

The centrally-planned countries account for roughly one-third of world production and consumption. They have been essentially self-sufficient in steel. The small volumes of trade between centrally-planned and market countries means that world prices are determined by production, consumption and trade of the market countries.

The developed countries of the OECD have long dominated international markets for steel; the industrial market countries (primarily the EC, Japan and the US) account for one-half of world production and consumption. This dominance owes to their early development of major steel consuming industries resulting from industrialization and more recently to the growth in their steel intensive manufacturing sectors, especially automobiles and machinery. As late as 1970 all 20 of the world's largest steel making firms were in OECD countries; these 20 firms accounted for almost 40 percent of world output. See Table 2.

This dominance by a few major steel producing firms has been eroded during the last two decades. By 1990, it took 30 additional firms, 50 in all, to account for 40 percent of world output. Moreover, 11 of these 50 firms are located in developing countries, 3 of which are among the current top 20 largest steel producing firms. Another interesting development is that, unlike in 1970, five of the world's largest firms in 1990 uses minimill technology -- Tokyo Steel and Tao Steel (Japan), Nucor and North Star (US), and Gerdau (Brazil). See Table 3.

This erosion of dominance by a few major firms also has influenced the degree of competition in world markets. During the early post-war period when demand for steel exceed supply, national markets were characterized as oligopolistic. Price competition was limited as the dominant firms played the role of price leaders. Over time world capacity and the number of firms has grown while demand growth in the higher income countries has slowed. Price competition has intensified. Today steel markets are highly competitive especially for merchant grade products.

These competitive pressures have induced many integrated firms to narrow the range of products produced and instead to concentrate on higher valued products such as cold-rolled and corrosive resistant sheet steel. Minimills have put intense price pressure on merchant grade steel product sectors. This is especially true in the United States and to a lesser extent in Japan.

Conversely, integrated mills in the EC have continued to produce a broad range of products. This difference may owe to government involvement, either through public ownership of steel making facilities or through government subsidies, reflecting various social objectives such as maintaining employment. Alternatively, management may believe that diversification across product lines is a prudent method to maintain revenue flows by offsetting weak cyclical demands for particular products with stronger demands for other products. Such diversification, however, is not all advantage. In order to maintain competitive facilities diversified firms must invest in a wide range of modernizing technologies at significant costs. Such investment demands to protect long standing product sectors will force these firms to forego certain opportunities to enter promising high value-added specialty product markets.

During the last decade, significant capacity has been taken out of operation by the industrial countries, other capacity has been modernized, and new minimill capacity has been created. Overall, total production by the industrial countries has remained essentially unchanged.

As a generalization it is still true that developing countries are consumers of steel produced in the industrial countries. The developing countries have invested in steel-making capacity; capacity has been expanding at an annual rate of 6.7 percent. During the last decade output has increased from 8 percent to 13 percent of world production. However, this is mostly the result of the efforts of a small number of developing countries which have doubled output since 1980; these countries include Brazil, India, the Republic of Korea, Mexico and Taiwan.[4] Nevertheless, the vast majority of developing countries still depend on imports for over half of their steel needs.

World consumption: Consumption, like production, is dominated by the market-oriented industrial countries; these countries account for one-half of world consumption. The CPE countries account for one-third of consumption; in contrast, the developing countries with their large populations account for only one-sixth of world consumption.

This skewed breakdown of world consumption is likely to change over time. Steel consumption by the industrial market countries and the CPE countries is growing quite slowly -- less than 2 percent per annum.[5] With economic growth, the developing countries' needs are increasing. During the 1980s, steel consumption has increased by almost 40 percent (3.6 percent annually).

---

[4]For historical reasons China is classified as a CPE country. Production in China has also doubled during the last decade, as has consumption.

[5]China is a clear exception to this generalization.

Steel is an intermediate product with demand being closely tied to the process of industrialization. Since industrialization involves manufacturing and, in turn, investment in plant, equipment and infrastructure, the demand for steel is related to the stage of development. Finally, large countries with large populations will have larger economies and larger demands for all commodities including steel. Putting all of this together leads to the conclusion that the demand for steel is related to a country's GDP.

Figure 1 plots steel consumption in quantity (1990) against per capita income (1988 US$) for 76 market countries, including 23 industrial and 53 developing countries. The data have been transformed into logarithms so that the interpretation becomes a relationship between the percentage increase in GDP and the corresponding percentage increase in steel consumption. The upward sloping lines depict the central tendency of this relationship. The slope of the dotted line is the coefficient of steel intensity in the economy.[6] If the slope is greater than one, steel consumption will increase by a greater percentage than the increase in GDP; if the slope is less than one, consumption will grow slower that GDP. The relationship is definitely not linear; the slope of the dotted line flattens at higher levels of GDP.

---

[6]The coefficient of steel intensity quantifies the percentage increase in consumption that occurs as a result of a 1 percent increase in per capita income. It is analogous to the economic concept of the "income elasticity of demand."

Appendix I develops an economic model of steel consumption. It begins with the traditional demand relationship that quantity consumed is related to the price of steel and the level of income of potential buyers. This relationship transforms into the "naive" linear relationship depicted in Figure 1. Economic theory can tell us which economic variables should be related and whether the relationship is direct or inverse, however, theory does not tell us whether the relationship is a straight line (linear), a polynomial, or some other functional form. This latter question is answered by statistical analysis, i.e., whether real world data confirm a particular hypothesized functional form. The statistical results presented in Appendix I reject the linear relationship between steel consumption and GSP.

An alternative relationship between steel consumption and GSP is developed in Appendix I. This alternative specifies an inverse relationship between the coefficient of steel intensity and the level of per capita income. The estimated relationship was then used to calculate values for the coefficient of steel intensity (the income elasticity of demand for steel) for each of the 76 sample countries. These values are plotted in Figure 2 along with the estimated theoretical relationship. For comparison, the "naive" relationship derived from the initial linear relationship is also plotted; it is a horizontal line with a coefficient of steel intensity of 1.11.

The coefficient of steel intensity is one (unity) for countries with per capita income of roughly US$2,000.[7] At this level of per capita income, consumption of steel will grow in strict proportion to the growth in the economy, i.e., if GSP grows by 4 percent annually, steel consumption will grow by 4 percent annually. For per capita income levels below US$2,000, the coefficient of steel intensity is greater than one. This indicates that as low income economies grow, the demand for steel will increase by more than the rate of growth of GDP. Conversely, high income economies have a coefficient of steel intensify of less than one. As these economies grow the demand for steel will grow slower than GDP grows.

There are three important implications of this relationship. First, all countries are undergoing economic growth. With very minor and isolated exceptions, per capita income in all countries increases over time. Since steel intensity decreases with higher levels of per capita income, the long term outlook for the steel industry is constrained. The growth in demand for steel will decline steadily over time. Clearly, there will be market pressure on the steel producing firms to limit the aggregate growth in world capacity over time.

[7] The World Bank divides developing countries into three classifications by level of per capita income. The three classifications are low- middle- and upper middle-income economies. The dividing line between the middle-income and the upper middle-income groups is just over US$2000. In our sample of developing countries only Brazil and Panama are classified by the World Bank in the middle-income groups yet have per capita income levels greater than US$2000.

There are several explanations for this decline in steel intensity. First, the more advanced countries have experienced a decline in the relative importance of steel intensive manufacturing and an increase in the size of service sectors which are less steel intensive. Second, the rapidly growing manufacturing sectors involve low steel intensive products such as consumer electronics, telecommunications, office and computing equipment, and scientific and measuring devices.[8] A third factor is the improvement in technology whereby yield rates have increased (i.e., the ratio of final product output to crude steel output) and the substitution of higher quality lighter gauge steel for heavier gauges, e.g., in automobiles and shipbuilding. A fourth, is the increased efficiency of steel consuming industries resulting in lower wastage and longer lasting steel products with reduced maintenance and replacement demands. And finally, the development of non-steel substitute materials has eroded some of the traditional markets for steel products.

Second, the above result relates income to the quantity of steel consumption. It must be noted that the developing countries are primarily consumers of heavier structural steel beams and shapes for construction projects. In contrast the developed countries primarily demand lighter but higher valued steel products such as coated sheet for appliance and automobile panels; moreover the heavier structural components of many uses

---

[8]See IISI, Changing Patterns of Industrial Development and the Steel Industry: Vol I, Brussels, 1990.

are being replaced by much lighter though equally strong structural shapes. In low income countries with high steel intensity coefficients, economic growth will increase the demand for lower value structural steels. As the middle-income developing countries move into the upper middle-income group their demands for steel will weaken. At the same time the composition of their demands will change from lower value structural steels to higher value sheet and strip. In the more advanced countries, where steel demand will grow slowly, it is likely that technological progress will produce new higher valued products that increase the value added in the steel industry. Thus, as growth in the quantity of output slows, value added may continue to grow at acceptable levels.

Third, on the positive side, rates of economic growth are not the same in all countries. The near term demand for steel will depend on which countries experience more rapid economic growth. If the low- and middle-income developing countries are successful in achieving rapid economic growth, their increasing demands for steel might be strong enough to create a strong world demand for steel. On the other hand, if these countries experience slow rates of economic growth, world demand for steel is likely to remain weak and become weaker. Similar conclusions relate to the future success of countries in Central and Eastern Europe (and China) in their efforts to transform into more market-oriented economies.

To summarize, in terms of the volume of steel demanded, the long term prospects are weak. With growth in the world economy the demand for steel increases at a decreasing though positive rate. In value added terms, however, the demand for steel is buoyed somewhat as higher income economies demand higher valued steel products. The weighted average steel intensity coefficient is 0.88; thus, a 1 percent increase in world GDP equally spread across all countries will increase the total quantity of steel demanded in all market economies by 0.88 percent.

Another positive development is that many of the low and middle income developing countries are undergoing dramatic reforms of their economic systems towards more market-oriented policies. The results of these reforms are likely to include an acceleration of their rates of economic growth. However, the weighted average coefficient of steel intensity among low- and middle-income developing countries is 1.00. Thus, any acceleration in these rates of economic growth will be accompanied by an equal proportional increase in their demands for steel unless the acceleration in growth rates is unequally distributed across developing countries in favor of the smaller countries which have higher income elasticities of demand for steel.[9] These countries account for 53% of the steel consumed by all developing countries and 11% of world consumption.

Regarding the industrial market countries, the average coefficient of steel intensity is 0.84 meaning that the growth in demand for steel will be 16 percent slower than their rate of growth in GDP. As indicated by the data reported in Table 1, these countries account for almost one-half of the world's demand for steel and almost three-fourths of the demand by all market economies. The only bright spot here is that these advanced countries demand higher valued added steel products. The future for steel firms selling to these countries requires continued product innovation towards higher valued added products.

4. World Trade in Steel

One-fourth of the steel produced in the world today is traded internationally. The market-oriented industrial countries account for two-thirds of world exports; the CPE countries and the market-oriented developing countries equally share the remaining one-third of world exports. See Table 4.

These proportions change somewhat on the import side. The market-oriented industrial countries are net exporters; thus, these countries only account for 60 percent of world imports.

---

[9]It was anticipated that the weighted average coefficient of steel intensity for these countries would be significantly higher than one, as implied by Figure 2. However, among this group the larger steel consuming countries have coefficients of steel intensity very near one or even less than one (India and Mexico); thus, the low weighted average.

Similarly, the CPE countries are also net exporters but in much smaller volumes. By the constraint of the world trade identity, the remaining countries, the market-oriented developing countries, are net importers and account for one-third of world imports.

These aggregations, however, are somewhat misleading. For example, the EC is the world's largest exporter, yet roughly one-half of these exports involve intra-EC trade (70 percent of EC imports originate within the EC). Net of trade among the EC countries, the EC accounts for one-fourth of world exports and 10 percent of world imports. The United States is the world's largest steel importer but is included in the net export group of countries. In 1984, when imports accounted for more than 25 percent of U.S. consumption, the United States accounted for 15 percent of world imports; however, by 1989 trade restrictions had reduced this latter share to 10 percent of world imports. Japan is a major exporter of steel products; yet exports have declined by 40 percent since 1980 owing to the increased demand by steel using industries in Japan. Like the EC, CPE exports are primarily destined to other CPE countries. China essentially consumes what is domestically produced and engages is very little international trade in steel products.

Imports account for almost one-half of the steel consumed by the developing countries. As with the developed and CPE country groups, aggregations for the developing countries mask important differences among developing countries. A few developing countries have increased production and exports quite dramatically during the past two decades. Exports from Brazil, Mexico, India, the Republic of Korea and Taiwan are growing by almost 10 percent annually; these countries now account for 10 percent of world exports. At the same time, the other developing countries as a group are experiencing small increases in exports and small increases in imports.[10] In total the developing countries have increased their share of world exports from 2 percent (1970-74) to 14 percent (1985-89) excluding intra-EC trade.

Export markets provided steel producers with growth opportunities between 1970 and 1985, but have declined since. Throughout the period 1960-89 the rate of growth of world exports of steel has been roughly double that of production, however, both rates fell dramatically from 9.5 percent and 5.4 percent during 1960-74 to 2.6 percent and 1.4 percent during 1975-89, respectively. The share of steel production that is exported increased from 20 percent in 1970-74 to 32 percent in 1985 but decreased to 27 percent in 1989. Growth in world trade in steel products has definitely not kept pace with the growth in world trade in manufactured products.

The reasons for the slowing rate of growth in world trade in steel products by the market-oriented industrial countries

---

[10]These developing countries are experiencing a rapid rate of growth in exports from a very small base level; the growth in these exports during the 1980s was only 4,000 metric tons, or 2 percent of world exports in 1990.

include: (1) CPE countries have become more self-sufficient and, therefore, import less; (2) several developing countries have become significant producers and exporters, especially Brazil, India, Korea, Mexico and Taiwan; (3) the globalization of the industry, e.g., Japanese firms investing in U.S. production facilities; (4) trade restraints, introduced by many OECD countries, have restricted the access to many of the important import markets, especially the United States. Since 1970, exports from OECD countries have remained relatively flat while exports from the major developing countries have increased dramatically, although from a rather small base.

Commodity Balance

Commodity balance analysis is based on the well known identity among production, consumption and trade. In all markets, aggregate supply must be equal to aggregate demand or absorption. The total supply available to an economy is determined by domestic production and the volume of imports. This supply is absorbed by domestic consumption and exports. Thus,

$$AggregateSupply = AggregateDemand$$

$$Production + Imports = Consumption + Exports$$

This identity can be rewritten as

$$Production - Consumption = Exports - Imports = NetExports$$

or

$$Consumption = Production + NetImports$$

Table 5 presents commodity balance data for 50 of the major steel producing countries; the twelve EC member states have been included as a single unit to net out intra-EC trade.

In the previous introductory section on global trade, it was stated that roughly one-fourth of the world's steel production is internationally traded. Since the various steel products are relatively homogeneous, one might expect the law of comparative advantage to apply. In this case, a country would be either an exporter or an importer of steel but not both. This, in turn, means that on average a country's steel consumption would differ from production by roughly 25 percent, some countries being importers and others being exporters. Further, since the countries included in Table 5 are the world's major producing countries, production for these countries should exceed consumption by a substantial margin.

However, the data presented in Table 5 demonstrate that this conclusion is far from the truth. Chart 1 is constructed from the last two columns in Table 5. The solid lines represent production and the white lines, net imports; the sum of the two represent consumption. When the white lines lie to the left of the vertical axis, net imports are negative and consumption is less than production.

Three of the five largest producing countries in the world (former USSR, the United States and China) are net importers of steel with consumption exceeding domestic production. And the other two among the five largest producing countries (the EC and Japan) export less than 10 percent of domestic production. In fact, only seven of the fifty countries included in this analysis have net exports of as much as 25 percent of production; these countries are Brazil, former Czechoslovakia, South Africa, Australia, Venezuela, Finland and Zimbabwe.

The most overwhelming conclusion that one gleans from this chart is that most of the major steel producing countries consume as much as they produce. Since (1) world trade accounts for 25 percent of world production and (2) the major producing countries consume roughly the same volume as they produce, the bulk of world trade in steel must be among the major steel producing countries. Moreover, the countries that do not produce large volumes of steel must be small consumers as well.

Several reasons might explain significant trade among major steel producing countries. For example, different producing countries might concentrate in different product sectors. For example, some countries might product heavy structural steels, others pipe and tube, others sheet and strip; the commodity balance might result from one country exporting heavy structural steel and importing sheet and strip. A variant of this explanation would be niche markets in which a country would specialize in the production of, say, specialty steels or corrosive resistant sheets for automobile panels and import commodity products such as bars and rods or structural steels.

A different explanation might lie with the structural organization of multinational steel enterprises. The major part of the steel industry consists of vertically integrated firms. Such firms produce the entire spectrum of steel products ranging from heavy plate and structural steels, to bars and rods, to pipe and tube, to hot rolled sheet, to cold rolled and corrosive resistant sheet, to specialty steels. As such firms move down the processing channel, they may locate facilities for particular processes in other countries. For example, Japanese firms locate rolling mills in the United States to meet the demands of traditional automobile customers who have invested in transplant factories in the Untied States.

Constant Market Share Analysis

The export performance of a country is influenced by a number of elements including the growth in the world market, the growth in particular products being exported, the growth in the important markets to which products are being exported and any change in the price competitiveness of the exporting country. Constant market share analysis is a well-known method used to evaluate and compare the export performance of various countries..[11]

---

[11]A brief description of the constant market share model is presented in Appendix 2.

However, the range of questions that can be examined are sometimes limited by the data available. Another serious limitation on the traditional application of this model in the present study is that world trade has been significantly affected by trade restrictions introduced by the major steel trading countries during the period under examination. Nevertheless, this method does enable one to draw important conclusions about the changing competitiveness of various countries in the global steel industry.

This model has been applied to thirty-six steel producing countries covering products included in SITC chapter 67 less 675. The results are presented in Table 6. The first two data columns present the country's share of world exports (excluding CPE countries) and an index of the country's relative export performance (defined below). The next two columns present the country's actual exports in thousand metric tons. The last three columns present projected exports in thousand metric tons under three constant market share assumptions: (1) the global trend figure is the volume of exports that would have prevailed in 1990 if the country's exports grew at the same rate as world trade in steel, i.e., by 6.73 percent annually from 1975 through 1990; (2) the major market figure is the volume of exports that would have prevailed in 1990 if the country maintained its import market share the countries to which its exports are destined; (3) the major product figure is the volume of exports that would have prevailed in 1990 if the country maintained its share of the world market for the country's major export products. The index of relative export performance (column 3) is the ratio of actual 1990 exports to the average of the three projected volumes of exports for 1990. See Appendix 2.

If the index of relative export performance is greater than unity, the country's exports grew more rapidly than the growth in the world market adjusted by the growth in the country's major markets and major products. Conversely, if the index is less than unity, the country's exports did not keep pace with the growth in the world market adjusted for major markets and major products.

The most obvious conclusions to draw from the results presented in Table 6 is that the most dynamic export performers are countries that began in 1975 with very small export bases. Of the top twenty export performers, only Spain exported sufficient volumes of steel in 1975 to account for even 1 percent of world exports. Each of the top six exporters accounted for less than 0.1 percent of world exports and in total they only accounted for 1.3 percent in 1975. Moreover, all of these top twenty exporters had 1990 export volumes that exceeded all three of the projected export volumes. This means that actual exports from each of these countries grew more rapidly than global exports, grew more rapidly than world exports to their major markets, and grew more rapidly than world exports of their major products. Clearly, these twenty countries have become more competitive in export markets using any of the traditional standards of measure. And they achieved these successes during a period when major importing country markets were protected by significant imports restraints.

Those countries with low export performance indices tend to be the prominent developed countries of Western Europe, North America and Japan. Japan is a special case. Japan's growth in steel exports between 1975 and 1990 has been a very slow 1.3 percent. However, a major factor contributing to this slow growth in exports is the increasing share of domestic production that is domestically consumed. For example, Japan's automobile industry grew rapidly during this period, absorbing an increasing share of Japan's steel output. Chile and India are the only developing countries to fall in the group of countries with export performance indices of less than unity.

Several of the advanced countries seem to have special stories. In the cases of Sweden, France, Belgium-Luxembourg, the Netherlands, Germany, Norway and Australia exports are concentrated in rapidly growing markets, however, these exporting countries have lost market share in these markets. These countries have also failed to keep pace with the growth in world exports of their major products. Germany, Norway and Australia have also failed to keep pace with the growth in world exports in general. Japan and the United States are also large producers whose export performance has not kept pace with any of the standards. Greece also falls into this category, however, the shortfall is quite modest by all three measures. All of these trends suggest a loss of international competitiveness for these countries.

The developed countries of New Zealand, Ireland, Switzerland, Spain, Portugal and Denmark are among the top twenty export performers. The export performance of the United Kingdom, Austria, Italy and Canada have also outperformed all three export projections.

5. An Economic Model of World Trade in Steel

Market outcomes are the result of the interaction of the demand for steel products and the supply of steel.

Supply: In the steel industry the major suppliers are large integrated firms. Balanced production facilities require a matching of front end capacity (i.e., furnaces and continuous casting through the ingot stage) and finishing capacity (i.e., rolling mills). Thus, integrated firms have very high capital costs. Input materials are typically purchased through long term contracts; some integrated firms actually invest in capacity to provide the needed raw materials. Labor union contracts also limit the firm's options regarding the size of the work force. Thus, input materials and labor are essentially fixed factors of production.

With large capital costs and long term contracts for input materials and labor, the total costs of the firm are relatively fixed as well. With these high levels of fixed costs, firms minimize average costs by producing at full capacity.

Conversely, average costs rise dramatically as the rate of capacity utilization declines. To economists, this means that full cost pricing requires a large mark-up of price over marginal cost.

Another characteristic of integrated plants is that the productive life of the capital equipment is very long; greenfield plants are prohibitively expensive. This presents a difficult problem with maintaining modern facilities. Technological innovation is introduced by specialized equipment that reduces wastage and improves the quality of the finished product rather than by depreciating plants and constructing new ones. Thus, the most efficient plant is the new plant. But almost immediately thereafter, any plant is less efficient than a new plant introduced by a competing firm or competing country. In this environment, firms are typically investing for a defensive reason, i.e., to catch up with the competition, rather than investing offensively, i.e., to develop a new technology or a new product niche.

In such an industry, output decisions are very lumpy. If a furnace is to be operated it must run at near full capacity. Thus, output decisions ultimately determine the number of furnaces to operate. At the same time, it is recognized that average costs is related to capacity utilization. Thus, the decision to shut down a furnace results in facilities being operated at, say, 66 percent or 75 percent capacity, and average cost will rise proportionately. Such changes in average cost can make the difference between small profits and very large losses.

These characteristics of the industry severely limit the range of management discretion in decision making. To put it simply, managers must forecast demand, and make output decisions, recognizing the consequences for average costs and profitability. Given the capacity in place, the long duration of contracts for material inputs and labor, the expected reactions of managers of competing steel firms and downstream customers, these managers are severely constrained to select an output volume that results in competitive prices (i.e., low average costs) which, in turn, dictates a high rate of capacity utilization.[12]

Once taken, an output decision controls the volume of output for a predetermined period of time. Unlike traditional economic theory, real life management does not permit a continuous variation in output in time and in volume. To restate the result: the output decision is lumpy. If output is to be decreased, it must be decreased substantially and the decrease must be decided far in advance of the actual date on which the decrease will become effective.

---

[12]In some cases, an output decision might require a decision to idle or retire capacity. Such decision, however, must take into consideration the financial position of the firm (can it afford the accounting cost of writing off substantial assets if it needs to maintain credit channels for working capital or to establish new credit). If such a decision requires the release of redundant workers, the firm must note possible effects on its unemployment insurance and retirement programs which, owing to many years of weak financial performance, may be underfunded.

The supply curve for an industry such as steel will be price inelastic in the short run. If an output decision changes output, the supply curve will shift dramatically when the new decision becomes effective. However, the new supply curve will again be price inelastic and will remain so throughout the period controlling the output decision.

Demand: The market demand is ultimately determined by the demand for steel products such as appliances, automobiles, construction, etc. The demands are subject to numerous market shocks. Given that steel is typically an input material rather than a final good, the market demand for steel is derived from the demand for the final goods. The elasticity of demand for inputs depends upon the available substitute materials and the cost share of the input. In the case of steel, substitute materials do exist in some case but are generally quite limited. Moreover, the cost share of steel in steel goods is typically low. As a result, the demand for most steel products is likely to be inelastic.

Steel products are sold directly to end users or through steel centers or other arms length arrangements. Commodity type products are most commonly sold through steel centers which can be likened to warehouse retailers. Steel centers take ownership of the steel and resell it to downstream users with a mark-up for center costs and profit. Steel sold directly by producers to end users is normally sold "made-to-order" under long term contracts, e.g., appliance and automobile firms contract for panels with special properties for molding, bending, application of paints, corrosion resistant, etc. These long term contracts often include provision for adjustments to price (e.g., to allow for higher materials costs to be passed on to the end user or to assure end users that prices will not become higher than those quoted by competing suppliers). Some high quality sheet steel will also be sold through steel centers and other arms length arrangements.

The point is that long term contracts do not mean that prices are fixed for long periods of time. The steel industry is extremely price sensitive in that prices will adjust upwards to downwards to equate supply and demand. At the same time, the demand is price inelasticity meaning that the total volume of steel sold in the market will not change significantly with variations in price. In such a market, price declines mean relatively large revenue losses for steel producing firms; conversely, price increases mean relatively large revenue gains for steel producing firms.

The steel market: The interaction of the market demand and supply yields the market price. Total market output will essentially equal the sum of the output decisions made by all of the firms in the industry. If the actual market demand is consistent with the forecasts, revenues will be as expected. If the actual market demand exceeds forecasts, market prices will be significantly higher than expected and the integrated firms will realize strong profits. Conversely, if the actual market demand falls short of the forecasts, market prices will be significantly lower and firms will incur losses.

Consider market outcome in the absence of international trade. For a given year assume that U.S. firms correctly forecast U.S. demand and set output decisions. Further assume that Japanese firms also correctly forecast Japanese demand and set output decisions. Finally, assume that European firms reach overly optimistic demand forecasts and set output decisions.

Under this scenario, the U.S. and Japanese markets will operate to produce expected rates of profit for their producers. However, the optimistic forecasts by European firms will result in overproduction and significant downward pressure on prices in European markets. Given the inelastic demand, price reductions will be greater in proportion that the volume of sales induced by the lower price. Total revenues for European firms will be lower than if they had correctly anticipated market demand and produced less.

Next consider the effects of international trade. Of course, output decisions are now more complex. Nevertheless, U.S. firms would forecast demand and allow for historical levels of steel imports in order to set output levels. Similarly, Japanese firms would account for historical exports in setting output levels. European firms would also account for exports it their output decisions. As before, assume that U.S. and Japanese firms arrived at correct market forecasts and output decisions whereas European demand fell short of forecasts; thus, European firms overproduce. If international trade flows were consistent with U.S. and Japanese firm allowances, steel prices in the United States and Japan would yield acceptable profits for these industries. However, overproduction in Europe would depress prices and yield losses for the European producers. Given the large number of producers in European and their propensities to export to other European countries, the price depression would spread throughout Europe; all firms would incur significant losses.

Owing to the inelastic demands, total revenues from steel sales in Europe would be lower that if sales in Europe were reduced by the amount of the overproduction. Consequently, it would be in the interest of European firms to divert the excess production to export markets outside of Europe. By so doing, prices in Europe would increase and generate an increase in total revenue received from sales in Europe even though the volumes sold in Europe would be smaller. In addition, exports to other markets would generate some additional revenues -- even if sold at significantly lower prices.

If the excess steel from Europe were to be dumped in the U.S. market, prices in the United States would fall with similar effects on total revenue from sales in the U.S. market. U.S. firms would incur losses and Japanese firms would lose revenue on their exports to the United States. If the Japanese home market were insulated from imports, prices in the Japanese markets would be unaffected. And as was the case for firms in Europe, Japanese firms would not have an incentive to divert low priced exports to their home market knowing that such diversion would lower prices and total revenues from sales in the Japanese home market.

An interesting corollary to this story is that market shares in the U.S. market would not be altered significantly. First, domestic firms facing import competition from European firms, but with no alternative markets in which to sell, would be forced to meet the price reductions and maintain their sales to traditional customers. U.S. firms would lose money but would not lose market share. Similarly, Japanese exports to the United States would yield lower prices and profits, but they would maintain their market share. Finally, European imports into the United States would significantly depress prices but would gain sales only commensurate with the increase in quantity demanded along the inelastic demand curve, i.e., by very little. The European share of the U.S. market would increase but by very little. Unless the European overproduction was quite small, they would be unable to dispose of it all; excess supply would remain unless it could be sold in other open markets.

This would be the market outcome if the Japanese market and European markets were protected from imports. If world trade were truly open, the lower prices in the United States would create incentives for U.S. firms to divert sales to Europe; Japanese firms would also have incentives to divert exports from the United States to Europe as well. And U.S. and European firms would have incentives to export to Japan. In this case, prices in the three markets would equalize at lower levels; total revenue for steel sales would decline in all markets; and all firms would incur losses. Market shares of various firms could change in all markets; however, to save transportation costs it would be more efficient for domestic firms to fill home country orders. The most efficient solution to a bad situation would be for market shares to remain stable.

To summarize the important market outcomes, overproduction by any country will result in lower prices in all countries open to import competition. But it is not likely to have near term effects on market shares.[13] The root of the problem might be unanticipated shocks in demand or output decisions based upon optimistic forecasts of demand. Overproduction might also be a problem for industries with government ownership or government concern that the industry operate at high levels of employment and capacity utilization.

In the case of private unsubsidized firms, consistent overproduction and losses must result in downsizing or bankruptcy. Overproduction by subsidized firms can be maintained. However, the effects of such overproduction on prices and profits of private firms in other countries will be a source of political conflict.

---

[13]Crandall (1981) constructs a model of pricing and market shares to test whether market outcomes are consistent with competitive market forces. He notes that prices are subject to significant short run fluctuations, however, market shares occur with a longer lag, up to two years for sheet products. Chapter 3.

6. The Role of Minimills: A Case Study

There are two distinct steel industries: (1) steel produced by the large integrated firms and (2) steel produced by the small minimills. The integrated firms make steel from basic raw materials (iron, coal and limestone) with continuous processing into finished steel products. Operating scales are very large, exceeding 2 million tons per year; capital costs are also very high. The expected life of a plant is roughly 20 years.

Minimills make steel from scrap using electric furnaces. Operating scales and capital costs are quite small relative to integrated firms. Minimills have short expected life spans and are continually modernized. Currently, the output is mostly commodity type products, i.e., bars, rods, shapes and small structural items.

Since 1970 integrated firms in the United States have downsized while the minimill sector has expanded in firm size and number. Total production of steel in the U.S. has declined by one-third during this period while at the same time production by minimills has increased by 150 percent. Minimills now account for about 20 percent of the steel produced in the United States.

The raw material for minimills is scrap that contains impurities that are difficult to remove. Consequently, the quality of the output steel is not as high as that produced by integrated plants. Currently, only integrated firms can make high quality sheet and strip, including corrosion resistant, such as required by the appliance and automobile industries.

However, technological advances are being made by the minimills; they are increasingly able to produce higher and higher quality steel. Their most recent inroads into the markets of the integrated firms include pipe and larger structural shapes; hot-rolled sheet and strip are soon to follow.[14]

The competitive advantage of minimills include small scale, low capital costs, and a rapid turnover of capital. The result is an industry with very modern plants that become more efficient over time. Minimills produce a narrow range of products using local scrap, and the output is destined to the same local market to minimize transportation costs. Labor productivity is higher than integrated plants and minimill wage rates are lower; thus, labor costs are much lower.

Scrap accounts for roughly one-third of the costs of producing steel using electrical furnaces. Thus, scrap prices are important to minimills. Given the low value of scrap, its heavy weight and low quality as an input, transportation costs can be significant. Consequently, the markets for scrap in the United States are regionalized. Minimills consider regional scrap supplies in their location decisions. Scrap price differences do occur between markets, e.g., 15% price differences between scrap markets in Chicago, Philadelphia and

---

[14]Faced with strong competition from minimills, Bethlehem Steel announced the closure of its structural I-beam facilities on January 26, 1994. Business Week, February 7, 1994, p. 36.

Pittsburgh.[15] However, from year to year prices in separate markets are very highly correlated.

Minimill technology is constantly improving. Given the relatively low cost of capital equipment, the implementation of new technology is feasible. In contrast, implementing new technology by integrated plants must often be done piecemeal owing to limited investment funds, yielding unbalanced facilities. Thus, integrated plants cannot be maintained as "state of the art" whereas minimills can.

Many of the competitive disadvantages of the integrated sector are the result of overly optimistic forecasts that followed the boom market of the early 1970s. The industry invested available funds to assure raw material supplies (e.g., iron ore) and to modernize. The limited investment funds required multi-year investment programs to achieve balanced facilities, i.e., balance between hot steel production and appropriate downstream processing facilities such as rolling mills. Poorly balanced facilities prevented the efficiency gains of continuous casting and rolling. However, declining consumption of the late 1970s proved the earlier forecasts to be in error.

Between 1977 and 1985 the major integrated firms in the United States reduced capacity and cut product lines that could be produced by minimills. But even after the reduction in capacity, most integrated firms still have facilities that are

[15]Barnett and Crandall, p. 75.

badly out of balance. To make matters worse they face serious constraints regarding plant closures. The companies have underfunded retirement programs; thus early retirement is not an option for many workers released in connection with a plant closing. And the government is concerned about mass layoffs and the implications for unemployment insurance programs, social security costs, etc.

But given the existing situation, the industry will be forced to close more plants, invest piecemeal to bring existing facilities into balance, reduce the range of products being produced, and to improve efficiency as best they can given limited investment funds.

Growth in steel consumption will be slow over the foreseeable future. Thus, growth in output from minimills must come at the expense of the integrated sector. The US integrated sector will also face increasing competition from imports.

It is anticipated that by the year 2000 40% of the steel produced in the US will be from minimills. This will result from integrated firms closing additional facilities that produce steel items that can be produced by the minimills (e.g., rods, bars, small structural shapes) and minimills continually upgrading the quality of their output and moving further into the product sectors controlled by the integrated firms (e.g., pipes and tubes, larger structural shapes, hot-rolled sheet).

Almost 30% of raw steel produced in countries outside the former CPE area is produced by electrical furnaces; the share is

25% in the EC, more than one-third in other western Europe and Latin America, and 25% in Asia. About one-third of the electric furnace capacity has been installed by integrated firms, primarily to extent the life of older facilities. In the EC the growth of minimill firms has been retarded by government subsidies granted to the integrated sector. Minimills are less feasible in developing countries owing to a scarcity of scrap steel.

Between 1974, a boom year, and 1985 U.S. consumption of steel declined from 120 million metric tons to 96 million metric tons. During the same period imports increased from 16 million metric tons to 24 million metric tons; exports declined from 6 million metric tons to 1 million metric tons; and minimill shipments increased from 8 million metric tons to 15 million metric tons. Thus, the market available to the large U.S. integrated firms declined by more than 40 percent. Of this 55 percent of the lost sales owed to the decline in U.S. consumption of steel products; the remaining 45 percent was split among imports, minimill competition and declining exports.

Regarding international competitiveness, U.S. import shares declined for those products produced by minimills, i.e., bars and rod, and domestic integrated firms held their own against imports at the high quality end, i.e., hot- and cold- rolled sheet and strip. However, import shares increased dramatically for the other integrated firm products, i.e., plate and structural shapes. It must be recognized, however, that import patterns during the last two decades have been heavily influenced by restrictive trade policies.

REFERENCES

Ranadev Banerji, "The export performance of less developed countries: A constant market share analysis," Weltwirtschaftliches Archiv, Band 110, 1974, pp. 445-457.

Donald F. Barnett and Robert W. Crandall, Up from the Ashes: The Rise of the Steel Minimill in the United States, Washington, D.C.: The Brookings Institution, 1986.

Robert W. Crandall, The U.S. Steel Industry in Recurrent Crisis, Washington, D.C.: Brookings Institution, 1981.

John P. Hoerr, And the Wolf Finally Came: The Decline of the American Steel Industry, (Pittsburgh, Pa: University of Pittsburgh Press, 1988).

IISI, Changing Patterns of Industrial Development and the Steel Industry: Vol I, (Brussels: International Iron and Steel Institute, 1990).

Edward Leamer and Robert Stern, Quantitative International Economics, (Boston: Allyn and Bacon, 1097).

David G. Tarr, "A general equilibrium analysis of the welfare and employment effects of U.S. quotas in textiles, autos and steel," (Washington, D.C.: U.S. Federal Trade Commission, 1989).

David G. Tarr and Morris E. Morkre, "Aggregate costs to the United States of tariffs and quotas on imports: General tariff cuts and removal of quotas on automobiles, steel, sugar and textiles," (Washington, D.C.: U.S. Federal Trade Commission, 1984).

Paul A. Tiffany, The Decline of American Steel, (New York: Oxford University Press, 1988).

USITC, "Steel industry annual report: On competitive conditions in the steel industry and industry efforts to adjust and modernize," (Washington, D.C.: U.S. International Trade Commission, 1991), USITC publication number 2436, September 1991.

USITC, "The economic effects of significant U.S. import restraints, Phase I: Manufacturing," (Washington, D.C.: U.S. International Trade Commission, 1989), USITC publication number 2222, October 1989.

USITC, "The economic effects of significant U.S. import restraints," (Washington, D.C.: U.S. International Trade Commission, 1993), USITC publication number 2699, November 1993.

USITC, "Certain flat-rolled carbon steel products from Argentina, Australia, Austria, Belgium, Brazil, Canada, Finland, France, Germany, Italy, Japan, Korea, Mexico, the Netherlands, New Zealand, Poland, Romania, Spain, Sweden, and the United Kingdom," (Washington, D.C.: U.S. International Trade Commission, 1993), USITC publication number 2664, August 1993.

APPENDIX 1

THE EFFECT OF ECONOMIC GROWTH ON STEEL CONSUMPTION

Following traditional economic theory, the demand for steel is specified as a linear homogeneous function of price and income,

$$Q = AP^{\epsilon}Y^{\eta} \qquad (1)$$

where Q is the quantity of steel demanded, P is price, Y is income (national GDP), A is a scale parameter, ϵ is the own-price elasticity of demand and η is the income elasticity of demand for steel. For estimation, the demand function is transformed into logarithms to obtain

$$\ln(Q) = A^{*} + \epsilon \ln(P) + \eta \ln(Y) \qquad (2)$$

where ln is the natural log transformation, A^* is ln(A), and other variables are as defined above.

Equation 2 is estimated using UNIDO data on consumption of crude steel during 1990 covering 76 countries. Since the sample is cross-country for a given year, the variance in the price variable is zero.[1] Consequently, the demand equation to be

---

[1]The price variation across countries would represent differences in transportation costs and differences in conditions of sale rather than price differences related to consumption. If the sample included data for several years, year-to-year variations in price would be related to consumption and the price variable would be maintained in the estimating equation.

estimated simplifies to a simple regression of ln(Q) on ln(Y). The estimated equation is

$$\ln(Q) = -4.72 + 1.11 \ln(Y) \qquad (3)$$
$$R^2 = 0.84 \qquad t(\eta) = 20.0$$

The estimated equation is highly significant in a statistical sense. This equation was then tested for linearity by specifying a second degree polynomial equation. Since the second degree coefficient was statistically significant, equation 3 is rejected as a naive relationship.

The naive and polynomial relationships are presented in Figure 1. The slope of the relationship between consumption and GDP is the income elasticity of demand for steel. Note that the polynomial relationship flattens as the level of GDP increases. Thus, the income elasticity of demand for steel is not constant; it is inversely related to the level of GDP.

The statistical sample being used to estimate the relationship includes developing and developed countries that differ dramatically by stage of development. It is hypothesized that the steel intensity in GDP is related to the stage of development with more advanced countries have a lower steel intensity and, in turn, a lower income elasticity of demand for steel. Low and middle income developing countries are major users of structural steels for construction and pipe for sanitation systems. Conversely, the more advanced countries are major users of high valued (low weight) steel sheet and strip for manufactured products, especially automobiles which require very high quality corrosive resistant sheets for automobile body panels.

The demand for steel is respecified as in equation 1, except that η is a function of the stage of development; per capita income is used as a proxy for stage of development. The revised relationship is

$$Q = A P^{\epsilon} Y^{\eta} \qquad \eta = a + b \cdot \ln(Ypc) \tag{4}$$

where Ypc is per capita income and all other variables are defined as above. Upon transformation into log form, we have

$$\ln(Q) = A^{*} + a \cdot \ln(Y) + b \cdot \ln(Y) \ln(Ypc) \tag{5}$$

where, as before, the price variable has been deleted. The estimated equation is

$$\ln(Q) = -6.24 + 1.47 \ln(Y) - 0.03 \ln(Y) \ln(Ypc) \qquad R^2 = 0.86 \quad t(a) = 12.5 \quad t(b) = -3.4 \tag{6}$$

The data fit this relationship very well with all estimated coefficients being highly significant.

The interpretation of the results is a little more complex than in the case of the naive relationship. In the former case, the estimated coefficient for η is the income elasticity of demand for steel. In equation 6, η is a function of Ypc and, thus, varies with the level of per capita income. Since the coefficient of b is negative, higher levels of per capita income yield lower income elasticities of demand. To quantify the income elasticity of demand for different levels of per capita income, we differentiate equation 5 (ln(Q) with respect to ln(Y)). However, since Ypc is defined as Y divided by population this differentiation is not as simple as it appears at first glance.[2] Upon differentiation, we get

$$d\ln(Q) = 0 + a\cdot d\ln(Y) + b\cdot\ln(Ypc)\,d\ln(Y) + b\cdot\ln(Y)\left(\frac{\partial\ln(Ypc)}{\partial\ln(Y)}\right)d\ln(Y)$$

$$\frac{d\ln(Q)}{d\ln(Y)} = a + b\cdot\ln(Ypc) + b\cdot\ln(Y)\left(\frac{\partial(\ln(Y)-\ln(POP))}{\partial\ln(Y)}\right) \tag{7}$$

$$\frac{d\ln(Q)}{d\ln(Y)} = a + b\cdot\ln(Ypc) + b\cdot\ln(Y)(1-0)$$

$$\frac{d\ln(Q)}{d\ln(Y)} = a + b\left[\ln(Ypc) + \ln(Y)\right]$$

Using the estimated coefficients, we can calculate the income elasticity of demand for steel η_y as a function of GDP and per capita income; this empirical relationship is

$$\eta_y = 1.47 - 0.03\left[\ln(Ypc)+\ln(Y)\right]. \tag{8}$$

Equation 8 was used to generate the data plotted in Figure 2 as "theoretical relationship;" the naive relationship (η_y=1.11) is also plotted. The figure clearly demonstrates that the steel

---

[2] In log form ln(Ypc) = ln(Y/POP) = ln(Y) - ln(POP), where Y is GDP and POP is population.

intensity of an economy is inversely related to GDP per capita. For Ypc levels less that US$2000 (1988), the income elasticity of demand for steel exceeds one; thus, the demand for steel will grow faster than the rate of growth of GDP. For Ypc levels greater than US$2000, the income elasticity of demand is less than one and the demand for steel will grow slower than the growth in GDP.

APPENDIX 2

THE CONSTANT MARKET SHARE MODEL

The Constant Market Share (CMS) model is designed to evaluate a country's export performance. The objective of this method is to attribute the increase in exports to various causes. There are four basic reasons that a subject country's exports by an industrial sector would increase over time. These include

1. growth in the world market for the products of the industry (the so-called global effect),
2. growth in the world market for particular products of the industry that account for the major share of the subject country's exports (the product composition effect),
3. growth in imports by particular countries that account for the major share of the subject country's export (the market composition effect), and
4. an improvement in the country's competitive position.

The global effect deals with the growth in world trade of finished and semifinished steel products. During 1975-1990 the annual growth rate was 6.73 percent. Thus, a country with average export performance should experience a 6.73 percent annual average growth in its exports of steel products.

The product composition effect compares a country's growth in particular steel products with the growth in the world market for those same products. For example, if a country's exports are concentrated in products for which the world market has grown more rapidly than the average 6.73 percent annually, then the country's exports of steel products should also grow more rapidly than 6.73 percent. Conversely, if such a country experienced an actual growth rate of only 6.73 percent, one might conclude that the country's export performance is below average.

The market composition effect compares a country's growth in steel exports to particular trading partners with the growth in those country's imports from the world. For example, if a country's steel exports are concentrated in rapidly growing markets the country's exports of steel should grow more rapidly than the average for the world.

The final effect, the so-called competitiveness effect, is calculated as a residual. Thus, if a country's actual exports grow more rapidly than can be accounted for by the global effect, adjusted for the product composition and market composition effects, the residual effect is attributed to an increase in competitiveness.[1]

The current application of the CMS model begins with a base year (1975) and calculates the growth rate in world exports for all products covered by the industry to the end year (1990); this yields a single aggregate global growth rate (ρ_w). Second, growth rates are calculated for world exports of each of the products covered by the industry; this yields separate global

[1]For a detailed development of the CMS model see Edward Leamer and Robert Stern, Quantitative International Economics, (Boston: Allyn and Bacon, 1970); for further discussion see Ranadev Banerji, "The export performance of less developed countries: A constant market share analysis," Weltwirtschaftliches Archiv, Band 110, 1974, pp. 445-457.

growth rates for each product (ρ_p). Third, growth rates are calculated for exports of all products to each importing market (i.e., region of the world); this yields separate industry growth rates for each market (ρ_m).

Once these various growth rates have been calculated, the model calculates, for a subject country, the hypothetical end year volume of exports that would have been realized if the country's export performance had matched the global experience. The global trend (GT) is

$$GT_i = \rho_W X_{Wi}$$

where X is the subject country's exports for the base year 1975, subscript W indicates the world, and subscript 'i' indicates the subject country.[2]

Second, the model was used to calculate, for each subject country, the hypothetical end year volume of exports that would have been realized if the country's export performance of each product had matched the global experience. The results is essentially a weighted average with the largest weights applied

---

[2]The growth notation has been simplified. In order to calculate the end year hypothetical volume of exports, the base year volume is multiplied by (1 + the annual growth rate) raised to the power of 15 to yield the compound growth in exports throughout the 15 year period. Thus,

$$\rho_W = (1+\rho_W)^{15}$$

to the country's major export products. The major product effect (MP) is

$$MP_i = \sum_{p} (\rho_p X_{wpi})$$

where X_{wpi} is exports to the world from country 'i' of product 'p' and ρ_p is the compound growth in world exports of product 'p'.

Third, the model was used to calculate, for each subject country, the hypothetical end year volume of exports that would have been realized if the country's exports to each market had matched those market country imports from the world. The major market effect (MM) is

$$MM_i = \sum_{m} (\rho_m X_{mi})$$

where X_{mi} is total exports from country 'i' to market 'm' and ρ_m is the compound growth in market 'm' imports from the world.

Finally, an index of relative export performance (REP) was calculated as the ratio of the country's actual export volume to the average of the three hypothetical calculated volumes. This index is

$$REP_i = \frac{(GT_i + MP_i + MM_i)}{3}$$

where GT, MP and MM are the three effects described above. If the index is greater than one, the country's actual export performance was better than the expected performance based upon the global growth in steel trade, the growth in world trade in particular products exported by the country, and the growth in the particular destination markets. In such cases, it can be concluded that the country became more competitive during the period 1975 through 1990. If the index is less than one, the country's actual export performance did not keep pace with the global trend, adjusted for the country's major export products and destination markets. The implication is that the country has experience a decline in its competitiveness.

Table 1: Production of Finished and Semi-finished Steel (000 metric tons)					
Country Group	Volume of Production		Share of World		Growth
	1981	1990	1981 %	1990 %	1981-90 %
Production of Steel, Shares of World Total and Growth Rate					
Industrialized Countries	322	337	57	51	0.5
EC	112	118	20	18	0.6
Japan	81	95	14	14	1.8
US	88	77	16	12	-1.5
Other Industrialized	41	47	7	7	1.5
Developing Countries	46	88	8	13	7.5
Major Developing[a]	38	67	7	10	6.5
Other Developing	8	21	1	3	11.3
CPE Countries	198	239	35	36	2.1
Former USSR	119	133	21	20	1.2
China	28	57	5	9	8.2
Other CPE	51	49	9	7	-0.4
WORLD TOTAL	566	664	100	100	1.8
Consumption of Steel, Shares of World Total and Growth Rate					
Industrialized Countries	286	331	51	50	1.6
EC	88	112	16	17	2.7
Japan	63	93	11	14	4.4
US	95	86	17	13	-1.1
Other Industrialized	40	40	7	6	0.0
Developing Countries	82	113	14	17	3.6
Major Developing[a]	40	62	7	9	5.0
Other Developing	42	51	7	8	2.2
CPE Countries	197	220	35	33	1.2
Former USSR	119	125	21	19	0.5
China	30	55	5	8	7.0
Other CPE	48	40	9	6	-2.0
WORLD TOTAL	566	664	100	100	1.8

Source: UNIDO data base. Spreadsheets from IISI Yearbook. The raw data were adjusted so that world production and world consumption are equal; the adjustments were quite small.

[a] Brazil, Mexico, India, Korea and Taiwan.

Table 2: The largest 20 steelmaking firms: 1970

Rank	Company	Country	Production million metric tons	Share of world percent
1	Nippon Steel	Japan	33.6	5.1
2	US Steel	USA	28.8	4.4
3	British Steel	UK	25.2	3.9
4	Bethelem	USA	18.7	2.9
5	NKK	Japan	12.9	2.0
6	ATH (Thyssen)	Germany	12.6	1.9
7	Sumitomo Metal	Japan	11.2	1.7
8	Kawasaki	Japan	11.0	1.7
9	Finsider	Italy	9.7	1.5
10	Republic	USA	8.8	1.3
11	Wendel-Sidelor	France	8.2	1.3
12	Usinor	France	8.0	1.2
13	National	USA	7.6	1.2
14	Armco	USA	7.2	1.1
15	BHP	Australia	6.8	1.0
16	Hoesch	Germany	6.8	1.0
17	Inland	USA	6.4	1.0
18	Arbed	Luxembourg	6.4	1.0
19	Jones & Laughlin	USA	6.3	1.0
20	Cockerill	Belgium	na	na

Source: USITC, Steel Industry Annual Report: On competitive conditions in the steel industry and industry efforts to adjust and modernize, (Washington, D.C.: US International Trade Commission, 1991), USITC Publication 2436, Table 2-1.

Table 3: The largest 50 steelmaking firms: 1990

Rank	Company	Country	Production millions metric tons	Share of world percent	Ownership P=private G=government	Facility I=integrated M=minimill
1	Nippon	Japan	28.8	3.7	P	I
2	Usinor Sacilor	France	23.3	3.0	G	I
3	POSCO	Korea	16.2	2.1	P/G	I
4	British Steel	UK	13.8	1.8	P	I
5	US Steel	USA	12.4	1.6	P	I
6	NKK	Japan	12.1	1.6	P	I
7	ILVA	Italy	11.5	1.5	G	I
8	Sumitomo Metal	Japan	11.1	1.5	P	I
9	Thyssen	Germany	11.1	1.5	P	I
10	Kawasaki	Japan	11.1	1.5	P	I
11	Bethelem	USA	9.9	1.3	P	I
12	SAIL	India	8.7	1.0	G	I
13	Arbed	Luxembourg	7.7	1.0	P/G	I
14	LTV	USA	7.4	1.0	P	I
15	Kobe Steel	Japan	6.6	0.8	P	I
16	ISCOR	S.Africa	6.3	0.8	P	I
17	BHP	Australia	6.3	0.8	P	I
18	China Steel	Taiwan	5.4	0.8	P/G	I
19	Dofasco	Canada	5.2	0.7	P	I
20	National	USA	5.2	0.7	P	I
21	Hoogovens	Netherlands	5.2	0.7	P/G	I
22	Inland	USA	4.8	0.6	P	I
23	Armco	USA	4.8	0.6	P	I
24	Cockerill Sambre	Belgium	4.4	0.6	P/G	I
25	Krupp Stahl	Germany	4.3	0.6	P	I
26	Sidermex	Mexico	4.2	0.6	G	I
27	Peine-Salzgitter	Germany	4.2	0.6	P	I
28	Voest Alpine	Austria	4.1	0.5	G	I
29	Hoesch	Germany	4.1	0.5	P	I
30	Ensidesa	Spain	4.0	0.5	G	I
31	Nisshin Steel	Japan	3.6	0.5	P	I
32	Tokyo Steel	Japan	3.5	0.5	P	M
33	Usiminas	Brazil	3.5	0.5	G	I
34	Klockner	Germany	3.4	0.4	P	I
35	Nucor	USA	3.1	0.4	P	M
36	Mannesmann	Germany	3.0	0.4	P	I
37	COSIPA	Brazil	2.9	0.4	G	I
38	CSN	Brazil	2.9	0.4	G	I
39	SSAB	Sweden	2.8	0.4	P/G	I
40	Sidor	Venezuela	2.7	0.4	G	I
41	North Star	USA	2.5	0.3	P	M
42	Stelco	Canada	2.5	0.3	P	I
43	Rouge Steel	USA	2.5	0.3	P	I
44	TDCI	Turkey	2.4	0.3	G	I
45	Weirton	USA	2.4	0.3	P	I
46	Rautaruukki	Finland	2.4	0.3	G	I
47	Gerdau	Brazil	2.4	0.3	P	M
48	Toa Steel	Japan	2.4	0.3	P	M
49	Tata Iron & Steel	India	2.3	0.3	P	I
50	Wheeling-Pittsburgh	USA	2.3	0.3	P	I

Source: USITC, Steel Industry Annual Report: On competitive conditions in the steel industry and industry efforts to adjust and modernize, (Washington, D.C.: US International Trade Commission, 1991), USITC Publication 2436, Table 2-2.

Table 4: Global Trade in Finished and Semi-Finished Steel (000 metric tons)

Country Group	Volume of Exports		Volume of Imports		Net Exports	
	1981	1990	1981	1990	1981	1990
Industrialized Countries	112	114	72	100	40	14
EC	66	71	39	61	27	10
Japan	28	17	7	2	21	15
US	4	3	18	16	-14	-13
Other Industrialized	14	23	8	21	6	2
Developing Countries	11	27	46	51	-35	-24
Major Developing[a]	8	20	11	15	-3	5
Other Developing	3	7	35	36	-32	-29
CPE Countries	20	28	23	18	-3	10
Former USSR	7	12	9	6	-2	6
China	1	2	3	4	-2	-2
Other CPE	12	14	11	8	1	6
WORLD TOTAL	142	169	142	169	0	0
Exports and imports as share of world total; net exports as share of domestic production or net imports as share of domestic consumption[b] (in percent)						
Industrialized Countries	79	67	51	59	12	4
EC	46	42	27	36	24	8
Japan	20	10	5	1	26	16
US	3	2	13	9	(15)	(12)
Other Industrialized	10	14	6	12	15	4
Developing Countries	8	16	32	30	(43)	(21)
Major Developing[a]	6	12	8	9	(8)	7
Other Developing	2	4	25	21	(76)	(57)
CPE Countries	14	17	16	11	(2)	4
Former USSR	5	7	6	4	(2)	5
China	1	1	2	2	(7)	(4)
Other CPE	8	8	8	5	2	12
WORLD TOTAL	100	100	100	100	-	-

Source: UNIDO data base. Spreadsheets from IISI Yearbook. The raw data were adjusted so that world exports and world imports are equal; the adjustments were quite small. The commodity balance identity requires gross supply (production plus imports) to equal gross demand (consumption plus exports); this identify also requires net exports to equal the difference between production and consumption. Unfortunately, statistics on international trade are not always consistent with statistics on domestic production and consumption. Thus, there are some inconsistencies between the data reported in Table 1 (for production and consumption) and those reported in this table.

[a] Brazil, Mexico, India, Korea and Taiwan.

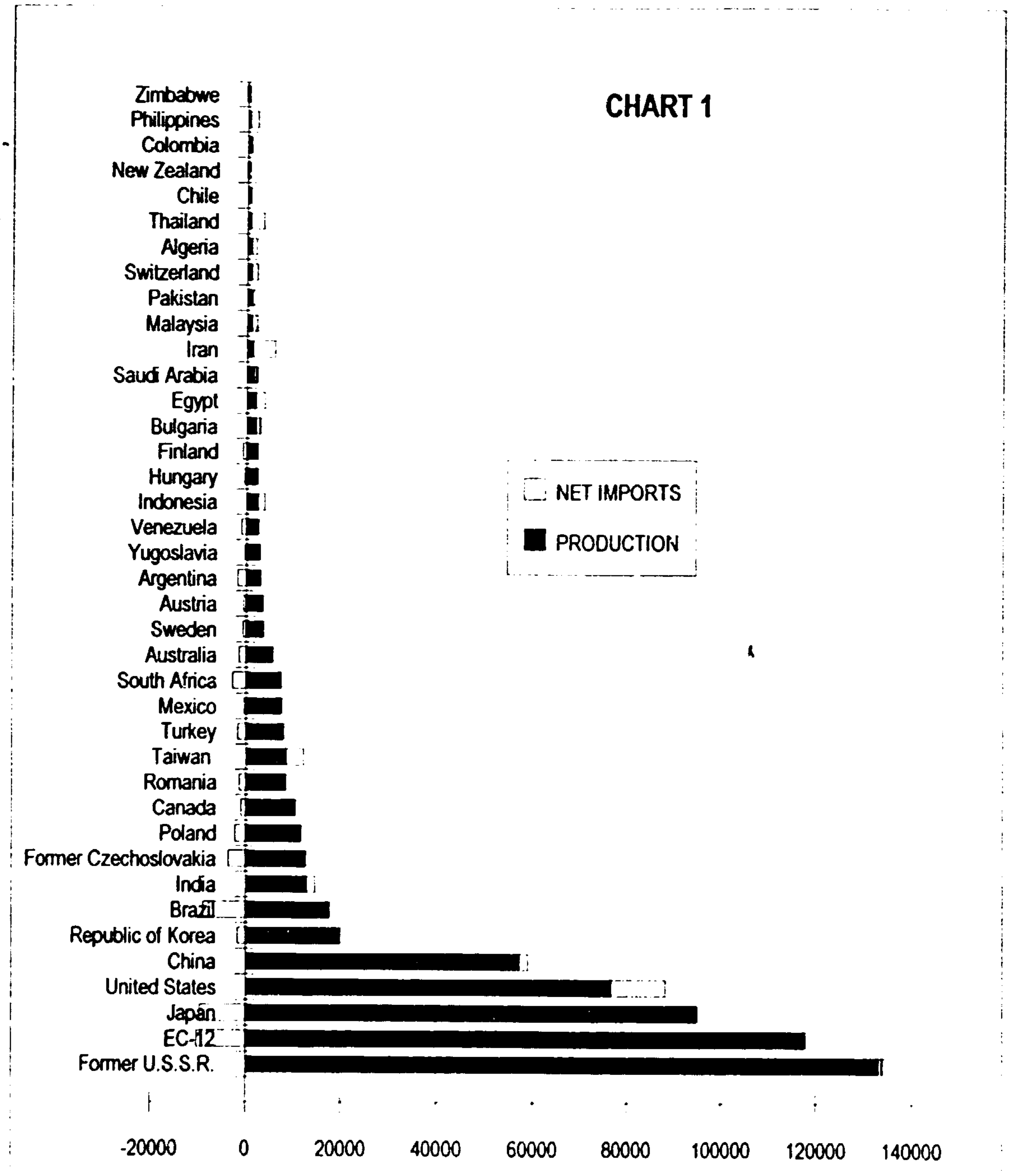
[b] The figures in parentheses are net imports as a share of domestic consumption.

TABLE 5: COMMODITY BALANCE

COUNTRY	IMPORTS	EXPORTS	CONSUMPTION	PRODUCTION	NET IMPORTS
Former U.S.S.R.	10,000	8,480	134,636	133,116	1,520
EC-12	61,188	71,291	107,874	117,977	-10,104
Japan	7,127	16,631	85,609	95,113	-9,504
United States	15,575	3,903	88,310	76,638	11,672
China	4,000	2,090	59,107	57,197	1,910
Republic of Korea	5,570	7,230	18,275	19,935	-1,660
Brazil	193	8,986	8,937	17,730	-8,793
India	2,100	306	14,693	12,899	1,794
Former Czechoslovakia	221	3,715	9,331	12,825	-3,494
Poland	236	2,458	9,531	11,753	-2,222
Canada	2,806	3,799	9,594	10,587	-993
Romania	562	1,902	7,069	8,409	-1,340
Taiwan	5,683	1,754	12,332	6,403	3,929
Turkey	2,153	3,811	6,378	8,036	-1,658
Mexico	1,049	1,404	7,150	7,505	-355
South Africa	148	2,947	4,631	7,430	-2,799
Australia	545	1,970	4,322	5,747	-1,425
Sweden	2,070	2,747	3,163	3,840	-677
Austria	1,711	2,172	3,238	3,699	-461
Argentina	267	1,966	1,439	3,138	-1,699
Yugoslavia	1,356	1,666	2,800	3,110	-310
Venezuela	226	1,243	1,722	2,739	-1,017
Indonesia	1,934	297	4,130	2,493	1,637
Hungary	1,355	1,780	2,046	2,471	-425
Finland	862	1,636	1,692	2,466	-774
Bulgaria	1,460	439	3,091	2,070	1,021
Egypt	2,300	100	4,127	1,927	2,200
Saudi Arabia	1,571	668	2,446	1,543	903
Iran	4,900	0	6,128	1,228	4,900
Malaysia	1,500	75	2,459	1,034	1,425
Pakistan	600	0	1,634	1,034	600
Switzerland	2,358	906	2,405	953	1,452
Algeria	1,300	0	2,205	905	1,300
Thailand	3,136	200	3,712	776	2,936
Chile	311	139	837	665	172
New Zealand	300	350	590	640	-50
Colombia	350	10	972	632	340
Philippines	1,900	30	2,387	517	1,870
Zimbabwe	100	305	300	505	-205

Souce: UNIDO secretariat calculations.

File COMM-BAL.XLS : 2/17/94



File COMM-BAL.XLS : 2/17/94

Table 6: Constant Market Share Analysis of Export Performance

COUNTRY	SHARE OF NON CPE MARKET 1975	RELATIVE EXPORT PERFORMANCE 1975-90	EXPORT VOLUME (000)MT 1975	EXPORT VOLUME (000)MT 1990	Projected Exports		
					GLOBAL TREND 1990	MAJOR MARKETS 1990	MAJOR PRODUCTS 1990
TOTAL 36 COUNTRIES	98.7		34,064.1	90,507.1			
TURKEY	0.03	44.24	11.7	930.8	31.1	16.8	15.2
COLOMBIA	0.01	21.62	3.6	171.8	9.6	5.1	9.2
ARGENTINA	0.05	17.54	19.1	708.1	50.7	32.0	38.3
THAILAND	0.01	11.56	5.2	137.9	13.8	11.7	10.3
MALAYSIA	0.02	10.58	5.8	189.2	15.4	24.3	13.9
EGYPT	0.01	8.02	3.7	74.2	9.8	8.0	9.9
BRAZIL	0.46	7.03	160.0	3,315.8	425.0	595.3	393.8
MEXICO	0.13	6.85	46.4	741.3	123.3	111.8	89.6
NEW ZEALAND	0.03	5.66	11.9	170.0	31.6	22.0	36.6
KOREA, S	0.62	4.64	213.4	3,276.7	566.9	947.0	604.6
IRELAND	0.04	4.25	13.7	164.7	36.4	46.0	33.8
YUGOSLAVIA	0.24	3.64	81.3	808.4	216.0	267.7	182.1
TAIWAN	0.27	2.98	91.5	1,013.4	243.1	563.0	214.2
FINLAND	0.44	2.87	153.2	1,243.4	407.0	439.4	455.5
SWITZERLAND	0.36	2.60	123.2	857.8	327.3	387.9	273.0
SPAIN	1.25	2.37	432.6	2,710.0	1,149.2	1,168.1	1,115.2
ZIMBABWE	0.13	1.95	43.7	210.4	116.1	107.3	99.7
PORTUGAL	0.09	1.94	30.2	168.1	80.2	107.8	72.5
SINGAPORE	0.25	1.86	86.4	431.8	229.5	273.3	191.9
DENMARK	0.35	1.58	120.8	526.2	320.9	341.7	337.3
UK	3.96	1.54	1,366.0	5,504.4	3,628.7	3,574.3	3,506.0
AUSTRIA	1.81	1.33	625.4	2,456.1	1,661.3	2,081.4	1,779.8
SWEDEN	3.17	1.29	1,096.0	3,369.2	2,911.4	3,546.5	1,386.5
ITALY	5.90	1.12	2,038.2	5,814.2	5,414.3	5,012.2	5,191.3
CANADA	2.14	1.08	738.4	2,059.4	1,961.5	1,872.2	1,889.4
FRANCE	9.97	0.97	3,442.1	9,182.4	9,143.7	9,873.5	9,275.2
BELGIUM-LUX	9.86	0.94	3,403.5	9,449.2	9,041.1	10,499.1	10,617.1
GREECE	0.42	0.94	144.2	358.9	383.1	373.9	390.1
NETHERLANDS	3.42	0.93	1,181.9	3,285.8	3,139.6	3,776.8	3,650.9
GERMANY, FR	17.10	0.91	5,901.4	14,624.3	15,676.6	17,205.1	15,557.8
CHILE	0.08	0.87	29.3	70.2	77.8	61.6	101.7
INDIA	0.33	0.70	115.2	239.2	306.0	427.1	284.8
NORWAY	1.50	0.70	516.6	1,017.2	1,372.3	1,724.1	1,287.6
USA	6.73	0.64	2,323.8	3,551.4	6,173.0	5,300.6	5,222.6
JAPAN	26.21	0.48	9,047.8	10,991.2	24,034.8	19,984.0	24,980.0
AUSTRALIA	1.27	0.48	436.9	684.5	1,160.6	1,629.8	1,521.1

Source: UNIDO secretariat calculations.

File UNIDO2.XLS: 2/17/94

Figure 1
Steel Consumption vs. GDP

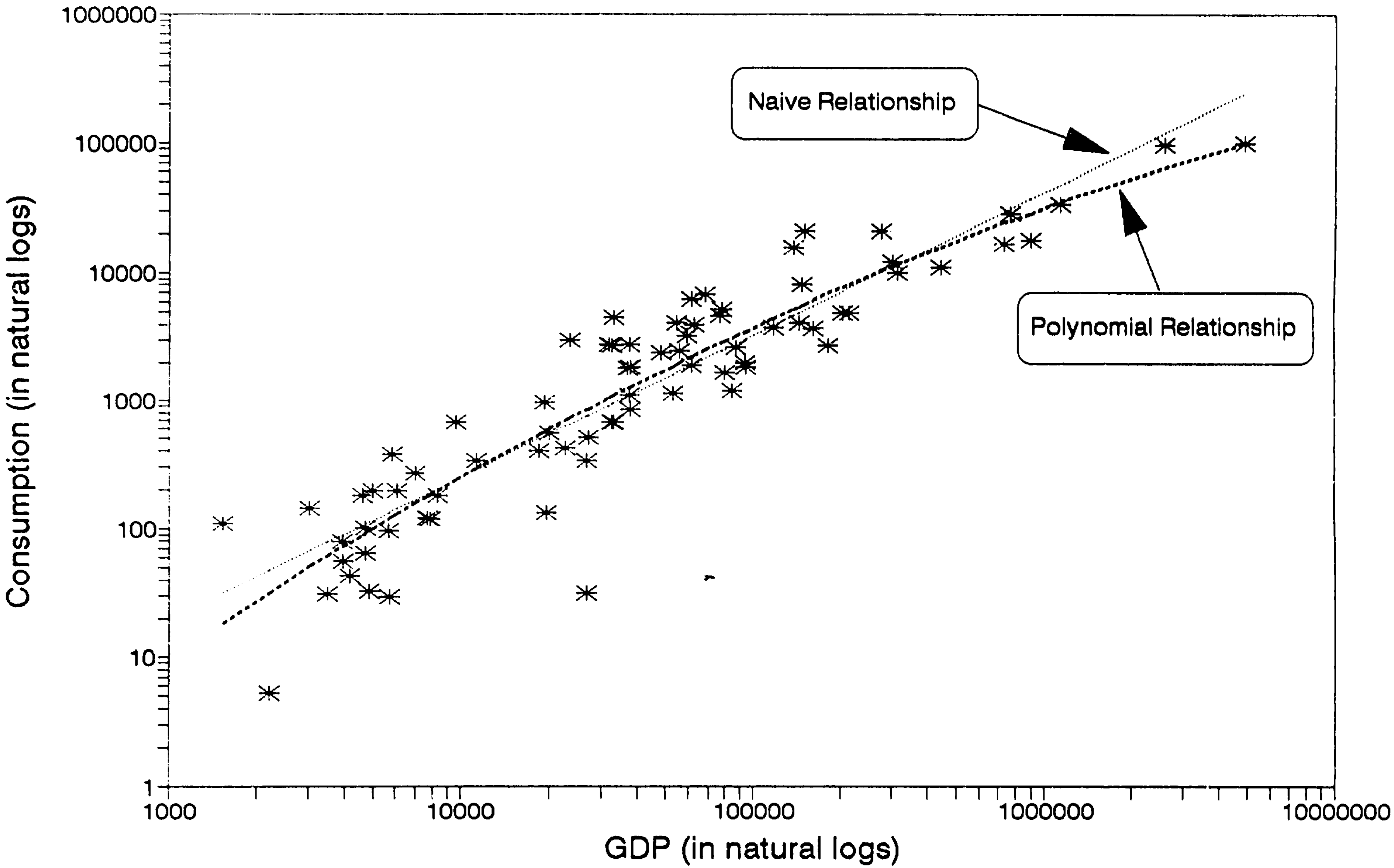


Figure 2
Income Elasticty of Demand for Steel