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THE WEST EUROPEAN STEEL INDUSTRY - STRUCTURE AND COMPETITIVENESS IN HISTORICAL PERSPECTIVE

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1. Introduction

As the steel industry in Western Europe faces the 80's, it is trying to recover from its most difficult decade since the Second World War. Crude steel production in the European Common Market (EEC 9) was barely larger in 1979 than in 1970. Non-European competitors threatened European steel producers in all their markets, both at home and abroad. Capacity utilization in the steel industry in the EEC in 1977 was only around 60 %.

This situation led to the adoption by the European Parliament in July, 1977, of the so-called Davignon plan for dealing with the crisis in the European steel industry. The plan consisted of a number of measures, both short-term (esp. minimum prices and import licenses) and longer-term structural ones. (1, pp. 10-14.) But regardless of how successful the plan would turn out to be in preserving short-run employment, hundreds of thousands of steel workers in Europe risked losing their jobs in the coming decade.

The primary purpose of this paper is to explain how the present situation in the West European steel industry has arisen. This will be done by analyzing the structure and performance of the industry in comparison with that of its competitors elsewhere over the postwar period. A secondary purpose is to get an idea of the technical and economic forces which have generated the present international crisis in the steel industry. It is hoped that by doing so we will be better able to understand the difficult problems now facing the industry.

1.2 Outline of the paper

The paper is structured in the following way. Section 2 gives a theoretical background concerning the relationship between the notions of structure and performance used in the conventional industrial organization literature (dealing with industry characteristics in a particular country) and those used in this study (dealing with international comparisons). Section 3 provides an overview of world steel production and trade in historical perspective. The links between the pattern of growth of steel demand and the industrialization process are emphasized. Special attention is devoted to the role of Western Europe and its trade, both intra-regional and with third countries.

Section 4 deals with the question of whether the international competitiveness of the West European steel industry has deteriorated in recent years and finds the answer to be affirmative. Sections 5 and 6 try to explain why this decline has occurred.

Section 5 goes into the structural determinants of international competitiveness such as the size structure of steel firms in various countries and various aspects of technical performance. Thus, an international comparison is made of production equipment in various processes within the steel industry, viz. blast furnaces, steel furnaces, and continuous casting equipment. In section 6, an analysis of relative factor price changes is made. Section 7 summarizes and interprets the results of the study. Some implications for the future, based partly on the findings of some other recent studies, are also discussed.

2. Theoretical background

2.1 The relationship between structure and performance

In the conventional industrial organization literature, the basic theory is that the structure of an industry in a particular country determines both the conduct and the performance of the industry. The main dimensions of industry structure usually considered are

> the extent to which the economy as a whole is dominated by large firms, the extent to which particular markets are dominated by one or a few sellers, the extent to which firms are diversified across numerous product lines, and the degree to which firms are vertically integrated. (See 2, p. 40 and 3, p. 33.)

Other dimensions of industry structure are the height of entry barriers, the extent of product differentiation, and the degree of buyer concentration. The aspects of conduct normally considered are pricing, marketing, financing, investment, research and development, and merger. Of the characteristics of performance, profitability and various aspects of efficiency are among the most prominent, along with certain equity and growth considerations. (See e.g. 2, p. 400 and 3, p. 33.)

This theoretical framework is designed for the analysis of industries within the context of a national economy. The problem with which we are concerned in the present study, however, is that of analyzing the performance of a particular industry, iron and steel, in Western Europe in relation to that of its major competitors in other parts of the world. Although it does not seem impossible to analyze the West European steel industry within the traditional framework, that is not the problem at hand. Given the extent to which the West European steel industry participates in trade with other regions (a topic which will be studied below), it does not seem meaningful to deal with the European steel industry problems in isolation from those in other parts of the world. However, by choosing this approach, we are required to develop a slightly different theoretical framework.

In the conventional model, industry structure is usually taken as exogenous. For our purposes, however, it seems more appropriate to treat both structure and performance as determined endogenously by a set of forces. These forces include the rate of growth and the size of the domestic market for steel (which in turn is a function of the level of development of the economy and especially of its infrastructure, as well as of the growth rate of domestic GNP), the character and rate of technological change, particularly with respect to economies of scale, relative factor prices, transport costs, the degree of openness of the economy, and the historical heritage of specialization in particular products or sub-markets. These are the principal forces which together determine the structure of the steel industry in a given country or region. The structure, in turn, influences both the conduct and the performance of the industry, as in the conventional model.

In this study we are concerned primarily with performance and secondarily with structure and conduct. _The main aspect of performance in which we are interested is international competitiveness._ The absolute level of international competitiveness of a country is a problematic concept, just as it is difficult to define an absolute measure of economic performance in the conventional approach. However, _changes over time in international competitiveness_ are more easily defined and interpreted: A country which maintains it profitability relative to other countries in a given industry while maintaining its share of a given market shows unchanging international competitiveness in that market. An increase (or decrease) in either profitability or market share, the other variable remaining constant, or an increase (decrease) in both variables, reflects increasing (decreasing) international competitiveness. The result is indeterminate if these variables move in opposite directions.

2.2 Determinants of international competitiveness

What, then, are the determinants of international competitiveness? There are at least four important elements: the degree of technical modernity, the relative cost level, the type and degree of specialization, and entrepreneurial skill (which determines the efficiency, the marketing and innovative performance, etc. - the total use of the company's or industry's resources). Thus, in order to explain changes in international competitiveness, we would have to gather information on all of these variables.

The degree of technical modernity. One of the main characteristics of the steel industry is that it is subject to large economies of scale which have increased over time. (See e.g. ref. 4 and 5.) Increasing scale economies may be regarded as one form of technical change. Other forms of technical change are represented by the introduction of basic oxygen converters, continuous casting, etc. Together with other factors, such as the initial conditions of the steel industry in various countries at the end of World

War II, the general rate of growth of the domestic economy and the size of the home market, etc., these aspects of technical change determine the structure of the steel industry in each country. Thus, an important dimension of structure is the degree to which the steel industry in a given country or region has adopted new technology and has an optimal structure of plant and equipment with respect to scale. This structural dimension is closely associated with the rate and type of investment.

The relative cost level. While the technical characteristics of the industry determine the input requirements of various factors of production, exogenous changes in factor prices may also affect the international competitiveness of the steel industry in a given country. We will therefore investigate whether the factor price changes that have occurred since the early 1960's have been more harmful in Europe than elsewhere.

Specialization. There is a great deal of variation in how countries specialize in various products requiring different production technologies, different marketing and service characteristics and different characteristics with respect to international tradability due to transport costs, etc. Differences of this kind are inherently difficult to measure. Therefore, the only aspect of specialization which will be touched upon here is the share of specialty steel (as opposed to ordinary or commercial steel) in crude steel production.

Entrepreneurial skill. This is an aspect of economic conduct which is difficult to formalize and measure and which is therefore often ignored in economic analysis. Leibenstein and others have dealt with at least certain aspcts of this problem. (See e.g. ref. 6.) The entrepreneurial skill determines the efficiency of total resource use within a company or industry, i.e. both allocative and technical efficiency of production as well as marketing, innovative activity, etc. For obvious reasons, this set of factors will be dealt with here only very superficially.

Thus, to summarize the theoretical framework, we are interested in explaining changes over time in international competitiveness. Changes in international competitiveness are defined as changes in international market shares, given that international relative profitability stays constant or changes in the same direction as market shares. Among the determinants of international competitiveness the following four are considered: the degree of technical modernity, the relative cost level, the type and degree of specialization, and the entrepreneurial skill.

In the next section, we will examine world steel production and trade in historical perspective and the role of Western Europe in this development.

3. World steel production and trade in historical perspective

3.1 Steel production and its regional distribution.

The world's largest steel producing countries in 1974 and 1978 are listed in table 1. The Soviet Union, the United States, and Japan are by far the largest steel producers, each with an annual output exceeding 100 million tons of crude steel. West Germany is the largest European steel producer, followed by Italy, France, and the United Kingdom. The crude steel production of the European Common Market countries (EEC 9) amounted to 132.5 million tons in 1978, i.e. smaller than that of the Soviet Union but larger than that of the United States.

It is noteworthy that while crude steel production fell between 1974 and 1978 in most Western industrialized countries, it increased in the U.S.S.R. and Eastern Europe and in developing countries. The largest relative increases can be noted for South Korea, Taiwan, and Brazil.

Figure 1 shows the development of world crude steel production and its regional distribution since 1913. Between 1913 and 1937, steel output rose by 2.4 % per year, between 1937 and 1950 by 2.6 %. During the period 1950-60 the rate of increase was 5.6 % and 1960-70, 6.1 % (7, p. 66). 1970-1979 the growth rate was 2.5 % per year.

Thus, in historical perspective it appears that the high growth rates in the 1950's and 1960's were "super normal" and those in the 1970's more normal - contrary to the common notion that growth in the 1970's was abnormally slow. This view is consistent with the notion that unique and extraordinary factors generated rapid growth during the first decades after the Second World War but have since weakened considerably: the closing of the technology gap between the United States and other industrial countries, the exploitation of large labor reserves in agriculture, the liberalization of world trade and internationalization of factor markets, etc. (See reference 8, e.g.)

Figure 1 shows that until the 1950's the world's steel production was dominated by Western Europe and North America. Together, these regions accounted for over 75 % of the steel produced. But since 1950, despite very high growth rates in Western Europe, steel production has grown faster in other regions, particularly Japan and Eastern Europe (including the U.S.S.R.) whose industrialization started later. Thus, Western Europe and North America now account for only slightly over 40 % of world steel production. In recent decades the share of the developing countries in world steel output has increased sharply and has now reached over 10 %. This represents nearly 70 million tons, corresponding to one-half of Western European steel production.

The changing regional distribution of the world's crude steel production during the 1970's is further illustrated in figure 2. While steel output increased by 13 % between 1970 and 1979 in the Western industrialized countries and by 40 % in the Communist countries (including China), it grew by 140 % in developing countries. As a result, steel production in developing countries doubled (from 6 to 12 %) as a percentage of the Western world's crude steel production. See figure 3.

These changes in the regional distribution of world steel output reflect what seems to be a common pattern in industrial growth: the steel industry is a basic industry which is of fundamental importance in building up the industrial infrastructure of any country. Therefore, the demand for steel products tends to grow more rapidly in the initial stages of industrialization than in later stages. As countries reach maturity, the growth rate of steel demand declines. Thus, it is only natural for the share of world steel production of the newly industrializing countries to increase at the expense of the more highly developed nations.

3.2 Changes in world steel trade

Over the post-war period, world steel trade as a proportion of total world steel production has increased, from about 10 % in 1950 to nearly 25 % in 1977. See table 2. Part of this increase can be attributed to increased economic integration in Europe. But even if intra-regional trade within the EEC and the Comecon areas is excluded, the share of trade in world steel output doubled (from 9 to 18 %).

In spite of the increased role of intra-regional trade, the share of Western Europe in total world steel trade has fallen sharply during the post-war period. Over 70 % of world steel exports originated in Western Europe over the whole period 1913-1960. (7, p. 67) However, already by 1970 the West European share had fallen to just over 50 % and has since fallen below that figure. Instead, the shares of Japan and of the developing countries have increased (from 5,5 and virtually zero, respectively, in 1960 to 26 % and 5 % in 1977). Thus, the share of the developing countries in world steel trade has not increased nearly as fast as their share of production, i.e. their production has been mostly for the domestic market. On the other hand, this means that the potential markets for steel exports from industrialized regions, such as Western Europe, have shrunk dramatically.

Table 2 indicates that trade among the EEC 9 and among the Comecon countries increased from about 2 % of total world trade in steel in 1950 to almost 7 % in 1977. The development of intra-EEC trade is further illustrated in figure 4. In 1950, trade among the EEC 9 countries amounted to approximately 7 % of their crude steel production. By 1977, this figure had risen to 27 %. Figure 4 also shows EEC exports to third countries. These exports were larger than intra-community trade until the mid-1960's. At the end of the 1970's, more than half of EEC steel production was exported to other countries within or outside the Community; in the early 1950's only about 1/3 of the steel produced was traded. Over the whole period, about 1/3 of the exports to third countries have been directed to other countries within Western Europe. (10, Annex II, p. 27.)

Turning now to an examination of the West European steel market as a whole (i.e. netting out all trade within Western Europe), it is noteworthy that steel imports into the region played a very insignificant role until 1969-70. According to table 3, imports in 1960 and 1965 amounted to only 2.5 and 3.1 million tons, respectively (crude steel equivalent weight). This corresponds to less than 3 % of apparent consumption. The import figure for 1970 of 12.7 million tons is abnormally large. It is due mainly to strikes in Italy in 1969-70 and to high domestic demand throughout Western

Europe in connection with a peak in the business cycle. This led to strongly reduced net exports in France and to large net imports in Italy which normally has had substantial net exports. However, imports to Western Europe from third countries have remained at a high level during the 1970's, at the same time as West European exports have increased sharply. While exports to third countries as a percentage of crude steel production fell from 15 to 11 % during the 1960's, this percentage nearly doubled between 1970 and 1975 (from 11 to 19 %). This was a result of both increased exports and reduced production in Western Europe.

An examination of the regional distribution of West European steel trade can be made with the aid of table 4. Exports to third countries have made up about 35-40 % of total exports since 1960, while imports from third countries have risen from about 10 % to 17 % of total imports between 1960 and 1975. Net exports have increased from approximately 10 to approximately 15 million tons per annum.

The bulk of West European steel exports to third countries went to non-industrialized countries in 1960. The exports to these countries diminished until 1970 but have increased in the 70's and now make up about one-half of the export volume. Exports to Eastern Europe have also increased sharply in the 1970's, while those to the United States have stagnated.

On the import side, the share of Japan rose very fast betweeen 1965 and 1975. In the latter year, more than half of West European steel imports from third countries originated in Japan. But the import volume was still fairly modest - only 3.8 million tons. Imports from Eastern Europe amounted to 3 million tons, while imports from North America and from developing countries were insignificant. Thus, it would be wrong to attribute the difficulties that the West European steel industry has faced in recent years to increased imports. These difficulties must have other causes. In particular, one notes that imports from developing countries hardly made themselves felt at all up to 1975. To the extent that these countries have had any substantial impact at all on the West European steel industry, it would seem to have been in reducing West European exports to North America and to the developing countries themselves.

According to table 5, the largest net exporting countries in Western Europe in 1975 were Belgium-Luxembourg, West Germany, and Italy, with net exports of 13, 10, and 4 million tons, respectively. France, Austria, Spain, and the Netherlands, in that order, were also net exporters. All other countries were net importers. Especially noteworthy is the strong export growth in the last five-year period in West Germany, Italy, and Spain. Almost the opposite may be said of the United Kingdom, where net exports of 4.5 and 3 million tons in 1965 and 1970, respectively, turned into net imports of 1.3 million tons in 1975.

This brief survey of West European steel production and trade in world perspective has shown that the diminished West European shares in the 1970's merely constitute a continuation of trends that have prevailed throughout the 20th century and that reflect a common pattern in industrial growth. According to this pattern, steel plays a crucial role in the early phases of industrialization and then declines in relative importance. The slowdown in the growth of demand for steel in the 1970's is a world-wide phenomenon, but it has hit the highly developed industrial economies particularly hard. Their steel production stagnated, while that of Eastern Europe and particularly that of developing countries increased substantially. Our analysis has also suggested that the world growth rate of steel output during the 70's has been on a par with that prior to World War II, and that the high growth rates in the 50's and 60's were due to extraordinary factors which have now weakened.

4. Western Europe's loss of international competitiveness

4.1 The development of market shares.

Turning now to the more immediate issues at hand, what has happened to West European market shares in recent years? By comparing tables 2 and 3 it can be calculated that West European exports as a percentage of world exports net of intra-regional trade fell from 45.2 % in 1960 to 28.2 % in 1975. At the same time, West European steel imports from third countries increased from 2.6 % of West European apparent consumption in 1960 to 7.1 % in 1975 (see table 3). Thus, the market shares of Western Europe have fallen in both the international market and the home market in this period. The only mitigating factor is that at the same time West European exports to third countries as a percentage of crude steel production increased slightly, namely from 15 to 19 % (table 3). But this increase has occurred entirely during the 70's when crude steel production stagnated in Western Europe and then fell. During the 60's the exports to third countries were nearly constant at 16-18 million tons, then rose to nearly 30 million tons in 1975. This suggests that West European steel producers went to exports when domestic demand fell in the mid-1970's.

While the market shares of Western Europe as a whole have fallen since 1960, the performance has been unequally distributed among countries. The countries which have experienced the strongest improvements in their net trade position are Belgium-Luxembourg, West Germany, Italy, the Netherlands, and Spain. The countries which have had the most serious deterioration are the United Kingdom, France, Turkey and Yugoslavia (see table 5).

4.2 Relative profitability performance.

Thus, taken by itself, the development of market shares would indicate deteriorating international competitiveness of Western Europe's steel industry since 1960. But in order to ensure that the proper conclusions are drawn, we also need to examine the relative profitability.

Unfortunately, data on profitability are difficult to come by and are difficult to interpret even when available. Book-keeping practices, tax laws, regulation, subsidies, industry definitions, the degree of vertical and horizontal integration, etc. vary from one country to another. Unless proper adjustment is made for such variations, it is impossible to make accurate international comparisons of profitability. One such attempt, made by the United States Federal Trade Commission, represents the best data set that I have been able to find. (See reference 11.) It is based on International Iron and Steel Institute data for the United States, Japan, and the European Community but covers only the period 1961-1971. The FTC study concluded that

> the United States has the highest profit rate, and the European Community the lowest, when profit is measured by net income divided by sales. However, when profit is measured by net income divided by stockholders' equity, the profit rates of the United States and Japan are approximately equal, and that of the European Community is, again, the lowest. (11, p. 504.)

The data on which the FTC findings are based are shown graphically in figures 5 and 6. For all the reasons mentioned earlier, however, it is not clear how absolute differences in profit rates should be interpreted. Since we are interested here only in changes in international competitiveness, we need to know only the relative movement over time of profit rates. In order to study how the relative profit rates have changed over time, linear regression lines for each geographical area have been drawn in figures 5 and 6. It is clear from both figures that profits tended to fall during the period as a whole in all the countries concerned. According to figure 5, net income as a percentage of sales fell somewhat more rapidly in Japan than in the U.S. and somewhat less rapidly in Europe (but from a lower level). When net income is measured as a percentage of equity (as in figure 6), both the profit level and the rate of change over time turn out to have been virtually the same in Japan and the U.S. Again, the relative decline in profits was smaller in Europe, partially reflecting lower absolute profit levels throughout the period. The differences between figure 5 and figure 6 reflect differences in the degree of equity financing, among other things.

Given the difficulties in interpreting profit data in general and absolute profit differences in particular, it is not possible to draw very strong conclusions from the data presented here. The profit trends have been the same (i.e. falling) everywhere. The small differences in the rates of decline that we observe do not seem to warrant the conclusion that there have been any substantial changes in relative profitability internationally, given the shakiness of the data.

4.3 Decline in international competitiveness during the 1960's

Unfortunately, these data cover only the period 1961-1971. Particularly in view of the development during the 1970's, it would have been interesting to be able to extend the comparison to that decade as well. Lacking such data, we will have to rely on other information for our analysis of international competitiveness. But before we go on to the next section, we can conclude that the available information suggests that while the profitability of West European steel production did not deteriorate in relation to that of Japan and the United States, West European market shares declined dramatically during the 1960's. According to tables 2 and 3, West European exports to third countries as a percentage of world exports net of intra-regional trade fell from 45 to 22 % between 1960 and 1970, i.e. by half. Imports to Western Europe from third countries rose during the same time from less than three to 8 % of apparent consumption. Thus, the international competitiveness of the West European steel industry declined unequivocally during the 1960's.

During the 1970's the market shares of Western Europe improved somewhat. West European exports to third countries as a percentage of world exports net of intra-regional trade increased from 22 % in 1970 to 28 % in 1975. Imports to Western Europe also fell in relation to apparent consumption during the same period, namely from 8.1 % to 7.1 %. But it appears that this relatively strong performance was achieved at the cost of reduced profitability. No strictly comparable data exist, but it seems likely that the profitability of the West European steel industry fell in relation to that in other parts of the world, particularly in the second half of the decade. Also the West European share of world crude steel production, which fell from 32 % in 1960 to 27 % in 1970, continued to fall; it reached 23 % in 1977. Thus, while it is not possible to draw any firm conclusion regarding changes in the international competitiveness of the West European steel industry during the 1970's, it is unlikely that the declining trend has been reversed.

We turn now to an explanation of why this decline has occurred.

5. Technical structure as a determinant of international competitiveness

5.1 The size structure of steel works.

It is a well-known fact that the steel industry is characterized by substantial economies of scale. Therefore, the size structure of steel firms in a particular country may give an indication of the modernity and competitiveness of the country's steel industry. It should be pointed out, however, that the size structure of plants would provide a much better measure. Unfortunately, no such data are available to the present study.

Table 6 shows the number of integrated steel enterprises and their size distribution in certain countries in 1960 and in 1975. In all countries, the size distribution shifted to larger sizes over this period. There was a reduction in the number of steel enterprises in many of the countries listed; in only one country, the Soviet Union, did the number increase. The reduction was greatest in the European Common Market countries, where the number decreased from 60 to 37. However, most of this change is attributable to the nationalization of the British steel industry in 1967 and the formation of a new entity, the British Steel Corporation. But in West Germany, too, the number was greatly reduced.

Given the level of steel output in these countries in 1975, it can be calculated that the average integrated steel firm in Japan produced 12.8 million tons of crude steel in 1975, to be compared with 5.3 million tons in the USA, 5.2 in the U.S.S.R and 3.4 million tons in the EEC 9. Thus, in spite of sharply increasing concentration in Western Europe, steel firms in the Common Market produced only about 1/4 of the output of average Japanese steel firms and only about 65 % of American and Soviet steel firms.

Similarly, table 7 shows that European specialty steelworks (plants) tend to be considerably smaller than those in other industrial countries. Although it has not been possible to calculate the average size of specialty steelworks in the Soviet Union and Japan, the size distribution data suggest that they are considerably larger than those in Western Europe. Those in the United States are 4-6 times larger.

Of course, part of these differences may be explained by differences in product mix. Specialty steel includes all steel containing more than a certain percentage of alloys. This includes stainless steel. In recent years, production techniques have been developed which permit production of stainless steel on a very large scale, whereas this is not true for other specialty steels. Also, for certain specialty steel products the entire world market may be smaller than 100 000 tons. For example, a Swedish plant with a capacity of only 50 000 tons produces 30-40 % of world production of high speed steel; and small Swedish producers are the world's largest producers of other specialty steel products (14, pp 342-3).

The share of alloyed steel in total crude steel production varies a great deal among countries. See figure 7. According to the figure, the degree of specialization in specialty steel is far higher in Sweden than in any other country. In 1975, specialty steel made up over 25 % of total Swedish crude steel production, vs. 14.5 % in West Germany and the United States and only 6 % in Italy.

Because of such international differences in product mix, it is necessary to examine the steel industry at a much more detailed level if one is to obtain an accurate international comparison of structure and competitiveness. Thus, in the following section, such an analysis will be made.

5.2. International comparison of production equipment in the steel industry

5.2.1 Blast furnaces

The raw iron process constitutes the largest and most capital intensive segment of an integrated steelworks. It is the part of the steel production process where economies of scale are the greatest and have increased the most in recent decades. The size structure of blast furnaces is therefore a good indicator of the modernity of a country's steel industry.

Table 8 shows that the average size of blast furnaces has increased dramatically in all countries since 1960. This is especially true of Japan, where the average production per blast furnace increased from 350 000 tons in 1960 to 1 700 000 tons in 1975. Japanese blast furnaces are by far the largest in the world, reflecting the enormous expansion of Japanese steel production since 1960. Soviet blast furnaces were the largest in 1960 (an average of 390 000 tons), but even though they doubled in size by 1975, they were then less than half the size of Japanese blast furnaces. American blast furnaces were the third largest in the world in 1960 but have since fallen behind those of some European countries (Italy and Belgium-Luxembourg).

In 1960 there were only about 10 blast furnaces in Western Europe with an effective volume exceeding 1200 m^3. In 1975 there were at least 70. At the same time the total number of blast furnaces in the European Common Market was reduced by half, from over 500 to about 265. In spite of this, European blast furnaces remained considerably smaller, on the average, than in competing overseas industrial countries. The table also shows that the countries with the greatest expansion of output also have the largest blast furnaces: Italy and Belgium-Luxembourg. Thus, even though blast furnaces have increased in size considerably everywhere, the countries that have had the highest growth rates have been able to take advantage more fully of scale economies. This has resulted in increasing differences among countries in the average size of blast furnaces. It is beyond doubt that the relatively slow-growing nations of North America and Western Europe have lost competitive power to faster-growing countries elsewhere, such as Japan, South Korea, Brazil, etc.

5.2.2. Steel furnaces.

In the next stage in the chain of production there are several processes to choose from. See table 9, which shows the distribution by process of crude steel production in various countries in 1978. According to the table, basic oxygen furnaces are now responsible for more than half of the world's production of crude steel. In the OECD area their share is even higher. In the Soviet Union and Eastern Europe, the open hearth (OH) process still dominates.[1] In Italy, Sweden, and the United Kingdom electric furnaces play a much greater role than in most other countries. This is due to the fact that these countries base their steel production on scrap to a

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[1] The reason why the open hearth process is being phased out in more and more countries is primarily the high fuel costs. While oxygen converters use liquid raw iron directly from the blast furnace as raw material and thus do not need to melt the raw material, open hearth furnaces use cold raw iron (= pig iron) and scrap. Melting the raw material requires a lot of energy, mostly in the form of fuel oil. Also, basic oxygen converters operate considerably faster and thus have higher capacity and lower labor and maintenance costs. On the other hand, open hearth furnaces are more flexible because of their melting capacity.

In a study based on 1962 data, the Economic Commission for Latin America found that oxygen converters had lower costs of all categories (salaries and wages, total direct costs, and capital charges) than either open hearth furnaces or electric furnaces (15, table 17, cited in 16, p. 538). In a Swedish study using 1974 prices, it was shown that the energy cost differential alone between oxygen converters and OH furnaces was sufficient to cover the capital cost of new oxygen converters (17, pp. 260-1). For a brief summary of the literature on this topic, see (11, pp. 483-7).

higher degree than other countries.xx The scrap is melted in electric furnaces. In the case of Sweden the large share of electric furnaces is linked to a considerably higher share of specialty steel than in other countries.[1] For obvious reasons, the share of oxygen furnaces in crude steel production is lower in countries with large electric steel production than in other countries.

Since few open hearth furnaces have been built outside the Soviet Union and Eastern Europe since 1960, the share of open hearth process steel can be said to represent a rough measure of the degree of obsolescence of steel producing equipment in various countries. According to table 9, the steel industry in the United States, West Germany, the United Kingdom, and Sweden are among the least modern in the OECD area, while that of Japan and the Benelux countries is the most modern. However, this rough meassure has to be modified in several ways.

<u>One</u> modification is obtained by looking at the historical development. In table 10, the distribution of crude steel production by process in various countries in 1965 is presented. At that time, the basic oxygen process had gained only limited shares, except in Japan where already at that time 55 % of crude steel was produced in oxygen converters. Open hearth furnaces dominated strongly in both the United States and the United Kingdom. In West Germany and France there was considerable production

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[1] In 1976 scrap use per ton of crude steel was 627 kg in Italy, 602 kg in Sweden, and 548 kg in the United Kingdom. This can be compared to 300-400 kg in the remaining EEC countries. (19, table 12.)

capacity in "other" processes, particularly the Thomas process. A comparison of table 10 with table 9 reveals that these processes had disappeared completely by 1978 in West Germany and essentially also in France. At the same time, both countries have greatly reduced their open hearth steel production.

All this has taken place despite a rather small increase in total steel ou+put.[1]

This implies that the West German steel industry was a great deal more modern in 1978 than is indicated simply by the relatively high share of open hearth steel. The large open hearth share may be attributable to the fact that this was still the dominating process in the world during the earlier part of the post-war period. At that time a considerable reconstruction of the German steel industry took place.

It should also be pointed out that the degree of capacity utilization was far below normal in most countries in 1978. This probably increased the shares of oxygen converters and electric furnaces at the expense of other processes. Cf. the discussion on capacity utilization below.

There are substantial economies of scale in crude steel production,just like in blast furnaces. This has led to rapidly increasing size of new equipment. The average size of oxygen converters in various countries in

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[1] For a discussion of the diffusion of basic oxygen converters in several countries prior to 1970, see (20, pp. 146-199).

the mid-1970's is shown in table 11. According to the table, the largest oxygen converters are to be found in Poland and Japan, the smallest in Sweden, France, and Austria.

The table also shows that while the converters built in the late 1950's were rather small (West Germany had the largest with an average output of 288 000 tons), those built in the late 1960's and early 1970's are very large, as illustrated by those in Poland (1.1 million tons).

As far as electric steel furnaces are concerned, international size differences are small relative to those for oxygen converters. See table 12. Electric furnaces are generally quite small, only a fraction of the size of oxygen converters or open hearth furnaces. This has to do with their use primarily as auxiliary scrap melting equipment. However, the figures for the United States and Belgium indicate that in cases when they are used as the primary source of crude steel, electric furnaces tend to be considerably larger.

5.2.3. Continuous casting

Another, and perhaps better, measure of the modernity of a country's steel industry is the share of its crude steel output which is continuously cast (as opposed to batch processed). It is a better measure in the sense that it reflects operating practices as well as scale economies.

In figure 8, the diffusion of continuous casting in Western Europe, the U.S., Japan, and the Soviet Union is represented. The process began to spread in the early 1960's, but the diffusion did not become rapid until the late 1960's. Sweden, West Germany, and Japan were among the earliest adopters, while diffusion has been slow in the U.K., France, and the U.S.[1] In 1978, the degree of diffusion was highest in Japan, Italy, Austria, West Germany and Sweden with the United States and the United Kingdom still lagging behind. The diffusion of continuous casting was still slower in the Soviet Union.

This is not necessarily to suggest management errors in countries where adoption has been slow. A slow adoption rate usually reflects slow overall growth of the steel industry in the country concerned. Thus, a study by the U.S. Federal Trade Commission shows that in relation to total capacity expansion, the U.S. rate of adoption of both basic oxygen converters and continuous casting techniques has been high relative to that of other countries (11, pp. 489 and 502). The implication of this is that the introduction of new technology has had to take place through replacement of old equipment in the U.S. and U.K. to a greater extent than in countries with higher growth where this has been achieved largely by expanding output capacity.

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[1] The break in the U.S. curve between 1970 and 1971 is due to the fact that the figures have beeen taken from different sources.

5.3 Energy consumption

The energy consumption per ton of output may also be taken as a rough indicator of the relative modernity of production equipment in various countries. See table 13. The table shows that Swedish steel producers have been relatively energy efficient during the 1960's and 1970's, although they were surpassed by the Japanese in the 1960's. The same has been shown to be true for blast furnaces alone (21, pp. 311-313), as well as for steel furnaces (19, table 20). In West Germany there has been a spectacular reduction in energy consumption since 1960: energy consumption per ton of crude steel in 1978 was less than half of that in 1960. Only the Japanese were more energy efficient. The table also confirms the impression one gets from other data cited earlier, namely that slow economic growth in the United Kingdom and the United States has slowed down the rate at which new technology is introduced. Among other things, this has led to relatively high energy consumption figures.

5.4 Summary of the technical comparison

In this section, several indicators of the technical performance of various countries have been presented. These indicators include the average size of blast furnaces, the share of the open hearth process in crude steel production, the average size of oxygen converters, the degree of diffusion of continuous casting, and the total energy consumption per ton of crude steel.

Obviously, this list of variables is incomplete and therefore somewhat arbitrary. Nevertheless, it does cover the bulk of operations in the heavy metallurgical part of the industry. It is felt, therefore, that an aggregation of these indicators would at least give a rough idea of the technical performance of the steel industry in the countries involved. Thus, a ranking has been made of each country according to each indicator, and an average rank has been computed. See table 14. It turns out that Japan is superior in all respects; its average rank in column 6 is 1.0. Italy and Belgium-Luxembourg also perform rather well technically; their average rank is 3.2 and 3.3, respectively. West Germany is in an intermediate position with an average rank of 4.2. Then follow France (5.2), the United States (5.4) and Sweden (5.6). At the bottom of the ranking list we find the United Kingdom (6.2) and the USSR (6.3).

Needless to say, these numbers should be viewed only as crude and partial indicators of technical performance. Taken by themselves, they have little meaning even if they measure what we would like them to measure. They need to be supplemented with other data, particularly regarding economic performance, in order to indicate international competitiveness. We shall return to this point shortly.

A closer examination of table 14 shows that, with a few exceptions, the rankings according to the various indicators are very similar. The relatively low West German rank with respect to blast furnace size and the share of open hearth furnaces has been touched upon earlier. It probably has to do with the reconstruction of the German steel industry after the war; between 1950 and 1960, West German crude steel output nearly trebled. Similar factors explain the small size of Swedish blast furnaces and oxygen converters. The Swedish crude steel production trebled between 1950 and 1960, and Sweden was an early adopter of oxygen converters. The high rank of the United States with respect to the size of oxygen steel converters has to do with the late adoption of this technology in the United States (cf. p. xx above). The table also indicates that blast furnaces represent one area of steel technology in which the USSR performs rather well. In other areas for which data are available, it ranks at the bottom of the scale.

It seems clear, then, that there is a close correlation between the technical performance of a country's industry and its growth rate of production. This view is corroborated if one compares column 7 with column 6 in table 14. The ranking according to the growth rate of crude steel production between 1960 and 1974 is virtually the same as that according to technical performance: the Spearman rank correlation coefficient (excluding the USSR) is 0.9083. Thus, in an industry characterized by substantial economies of scale, a high and steady rate of growth leads to a steady flow of investment and continuous updating of equipment and maintained or increased competitiveness. A slow rate of growth entails stagnating investment, relatively old capital equipment, poor technical performance, and loss of competitiveness.

6. Relative cost performance

6.1 International comparison of input prices during the postwar period.

However, as indicated earlier in the theoretical section, technical performance by itself is not sufficient to determine international competitiveness. We also need information on economic performance, i.e. how the production equipment is used and with what degree of success various factors of production are combined to take advantage of international differences in relative factor prices. It is conceivable, e.g., that a country whose production facilities have become technically obsolete may still remain competitive due to a more favorable development of input prices than in other countries.

In order to deal with this problem, I have made an investigation of the development of prices of major inputs in the steel industry in the United States, Japan, West Germany, and Sweden over the 1960's and 1970's. The results are shown in figures 9-14. The sources of the data and the methods used are described in the Appendix. The inputs whose prices are compared are labor, iron ore, scrap, coking coal, heavy fuel oil, and electric power. Together, these account for over 70 % of total variable steelmaking costs in the United States in recent years -- but, due to differences in output mix and production techniques, for less than 40 % of total variable costs in Sweden in 1975. (11, p. 96; see also the Appendix.) In all of the figures except figure 10, the input price in each country is shown relative to that in West Germany for each year, i.e. as an index where West Germany is equal to 100. The basic assumption is that West Germany is representative of Western Europe as a whole.

Comparisons of this kind must always be regarded with a great deal of skepticism. The problem of obtaining strictly comparable data are simply enormous. Therefore, great caution is necessary when interpreting the figures. However, the data are the best that I have been able to find. At least as far as I have been able to determine, they do not contain any obvious errors or inconsistencies.

What, then, do the results indicate? As far as labor, the largest cost component, is concerned, there has been a considerable reduction in the relative differences in hourly wages over the 1960's and 1970's. See figure 9. This is only to expected, given the rapid increase in international trade and technical interchange. The wage per hour has fallen rapidly in the United States and increased in Japan in relation to that in West Germany. The Swedish wage has also fallen somewhat relative to the West German one.

Contrary to the relative wage development, the relative price differences regarding iron ore seem to have increased. See figure 10. The relative decline of the iron ore price in Japan is probably due largely to substantial reductions in overseas transport costs and to the exploitation of new mines, especially in Australia. High costs of domestic ores and high overland transport costs have kept the iron ore price relatively high in the United States.

As far as scrap is concerned, it is difficult to find any long-term relative price changes -- see figure 11. Regarding coking coal (figure 12), the international price differences have narrowed since the mid-1950's.The abundance of coal in the United States has kept the price of coal relatively low while the policy of the West German government to support the price of domestic coal has resulted in a relatively high coal price in Germany.

Seen over the whole period 1960-1975 there was little change in the relative price of heavy fuel oil in the countries concerned. See figure 13. But if the late 1960's is taken as the starting point for the comparison instead, there has been a considerable reduction in the price spread.

Finally, as far as electric power is concerned, there has been virtually no change in relative prices other than the dramatic price increases in Japan in recent years, with the result that the Japanese electricity prices have approached those in West Germany. See figure 14.

Except as regards wages, it is difficult to say, based on this comparison, that input prices, have developed in either a favorable or an unfavorable way to West European steel producers. Therefore, one cannot argue that relative factor <u>prices</u> have moved against Western Europe during the last few decades. If this conclusion is correct, it would imply that whatever deterioration there may have been in the West European steel producing <u>cost position</u>, it must be due to factors sch as technical obsolescence, overall inefficiency, unfavorable specialization, etc.

An attempt has been made in the Appendix to weight together factor prices and input coefficients to obtain a measure of relative cost changes between 1960 and 1975. However, the coverage and the quality of the data are not such that any firm conclusions may be drawn. Perhaps the only conclusion one can draw is that in order to be relevant, cost comparisons must be made at a much more disaggregated and detailed level. This point is further illustrated in the following comparison of labor productivity and unit labor cost.

6.2 Labor productivity and unit labor cost

Labor productivity is often used as a partial measure of economic performance. But because of widely different definitions of the steel industry among countries, it is not as easy as it may sound to make an accurate and relevant comparison. In table 15, employment and labor productivity data for the steel industry in varous countries according to two different sources are compared. For example , according to data supplied by the International Iron and Steel Institute, employment in the steel industry in the EEC countries in 1974 was nearly 800 000 persons. But according to United Nations data, the total number of persons engaged was nearly 1.8 million.

In the IISI statistics, output is measured in terms of crude steel production. In the wider definition used by the U.N., output is measured as value added. If the narrower industry definition used by the IISI is employed,crude steel output per person is a poor measure of labor productivity when the degree of processing beyond the crude steel stage varies as much as it does. The further the processing goes, the less relevant the measure becomes. This is illustrated in the Swedish case, where about two-thirds of value added is made up of special steel. Therefore, Sweden ranks very low in column 3 but very high in column 6.

Thus, considerable caution must be exercised in interpreting table 15. But it does seem to indicate that labor productivity is rather low in Austria and the United Kingdom, no matter which definition is used, and that it is rather high in the United States and Luxembourg. Except for Britain, the productivity differences do not seem very large within the European Common Market. The Japanese labor productivity appears to be no different from that in the Common Market.

In column 7, the total wage costs per hour in the steel industry in 1974 have been indicated. These costs were highest in the United States, Sweden, and West Germany and lowest in the United Kingdom, Japan, and Italy. If one assumes that the number of hours worked per year is roughly the same in all the countries listed, and that the indicated wage costs refer to the same definition of the steel industry as in column 6, an index of unit labor cost can be obtained. The results of such a calculation are shown in column 8. They indicate that in 1974, unit labor costs were about 9 % lower in Britain than in Japan, that those in Italy were about 17 % higher than in Japan, and that those in other West European countries and the United States were 35-40 % higher than in Japan.

6.3 Summary of the relative cost comparison

What conclusion can we draw from the relative cost comparison? The main argument put forward in the preceding section is that in order to make relevant and accurate international cost comparisons, one needs very detailed data. At the aggregate industry level, there are not many conclusions one can draw. Some basic weaknesses in labor productivity comparisons have been pointed out. In addition, since labor productivity is only a partial measure, it is of limited significance.

In an attempt to make a more complete cost comparison (including several of the major inputs beside labor) it was found that the heterogeneity of the industry made it practically impossible to draw any strong general conclusions.

In a comparison of the development of prices of major inputs to the steel industry in various countries, it was found that Western Europe has neither gained an advantage nor suffered a disadvantage relative to the United States and Japan since 1960. Thus, to the extgent that the present difficulties of the West European steel industry can be attributed to cost factors at all, they must be connected with non-price factors, such as technical obsolescence and inefficient resource use.

7. Summary and conclusions

The major findings in this study may be summarized as follows.

The West European steel industry has lost international competitiveness over the past decade, particularly to Japan and to the newly industrializing countries. (South Korea, Taiwan, Brazil and Mexico, e.g.). According to the information at hand, profitability in the West European steel industry seems to have been lower throughout the 1960's than in the United States and Japan, but there was no decline in profitability relative to these other countries. However, there has been a pronounced decline in West European market shares both at home and abroad. Imports to Western Europe from third countries (i.e. net of intra-regional trade) rose from less than 3 % of apparent consumption in 1960 to 8 % in 1970. During the same period, West European exports to third countries as a percentage of world exports net of intra-regional trade fell by half, from 45 % to 22 % between 1960 and 1970. The West European share of world crude steel production fell from 31 % in 1960 to 23 % in 1977.

This development is part of a historical and international pattern of economic growth. In the early phases of industrialization in any country, the demand for steel is large. The build-up of the industrial and social infra-structure requires large quantities of steel: industrial plant and equipment, transport and communication facilities, energy supply and distribution, etc. But as an economy reaches industrial maturity, the rate of increase of demand for steel tends to decline. Therefore, the newly industrializing countries gain world market shares at the expense of the more mature industrial economies.

The decline in the rate of increase of steel demand in Western Europe and the United States relative to that in other parts of the world has meant that these more mature economies have not been able to update their steel production facilities at the same rate as other countries. That is to say, the age of their steel production facilities has increased relative to that in more rapidly industrializing countries.

Even though the rate of growth of steel output has slowed down in the 1970's, that does not seem to be true of scale economies in the industry. The data presented in section 5 suggest that economies of scale have continued to increase at an undiminished rate. If this is true, the slowdown in the rate of growth of output means that it has become more and more difficult to find market room for new full-scale plants in the mature industrial countries. The lure of substantial scale economies in itself may have generated overinvestment, since steel firms have learned throughout the postwar period that one of the best ways to deal with declining competitiveness is to build new capacity. At any rate, the steel output capacity of the Western industrial countries continued to increase at least through 1978. Besides the cost advantages offered by new investment, the long investment lead times and gestation periods in the industry as well as overly optimistic demand forecasts in the early 1970's also contributed to this development.

The result of this, of course, was a very considerable overcapacity in the industry by the end of the 1970's. See figure 15. Based on the data supplied in the figure, it is possible to calculate that the capacity utilization rate in the OECD area in 1978 was only around 70 % and even less in 1977. The corresponding figure for the EEC for 1977 was around 62 %. At the peak of the business cycle in 1973-74, the capacity utilization rate in the OECD area was about 87 %. If one takes the difference in the capacity utilization rates between these two years (i.e., 87 - 70 = 17 %) as a measure of the overcapacity of the steel industry in the OECD area in 1978, this would correspond to about 87 million tons. Part of this capacity has probably already been scrapped, i.e., the capacity figures may be somewhat inflated. But it is still clear that there remains a considerable overcapacity, perhaps in the order of magnitude of at least 50 million tons of annual capacity.

It is inevitable that such a large overcapacity will influence prices and profitability for a long time to come. It does not seem likely that any substantial capacity expansion will take place; most likely it will be a question of scrapping older plants and partially replacing them with new plants.

This is the background against which the development in the industry in the next few years must be considered. Even at a historically "normal" rate of growth of demand for steel of 3 % per year, the overcapacity in the steel industry in the OECD area would be eliminated only towards the mid-1980's. Many factors point to an even lower growth rate. If hat should be the case, it would imply continued low prices and low rates of return on expansive investments. On the other hand, cost-lowering (rationalization) investments may give high yields.

However, any estimate of overcapacity suffers from considerable uncertainty. It is difficult to judge how much capacity has already been scrapped in the OECD countries. It is even more difficult to guess what actions various governments will take to protect their own steel industry and prevent the necessary closing down of obsolete plants.

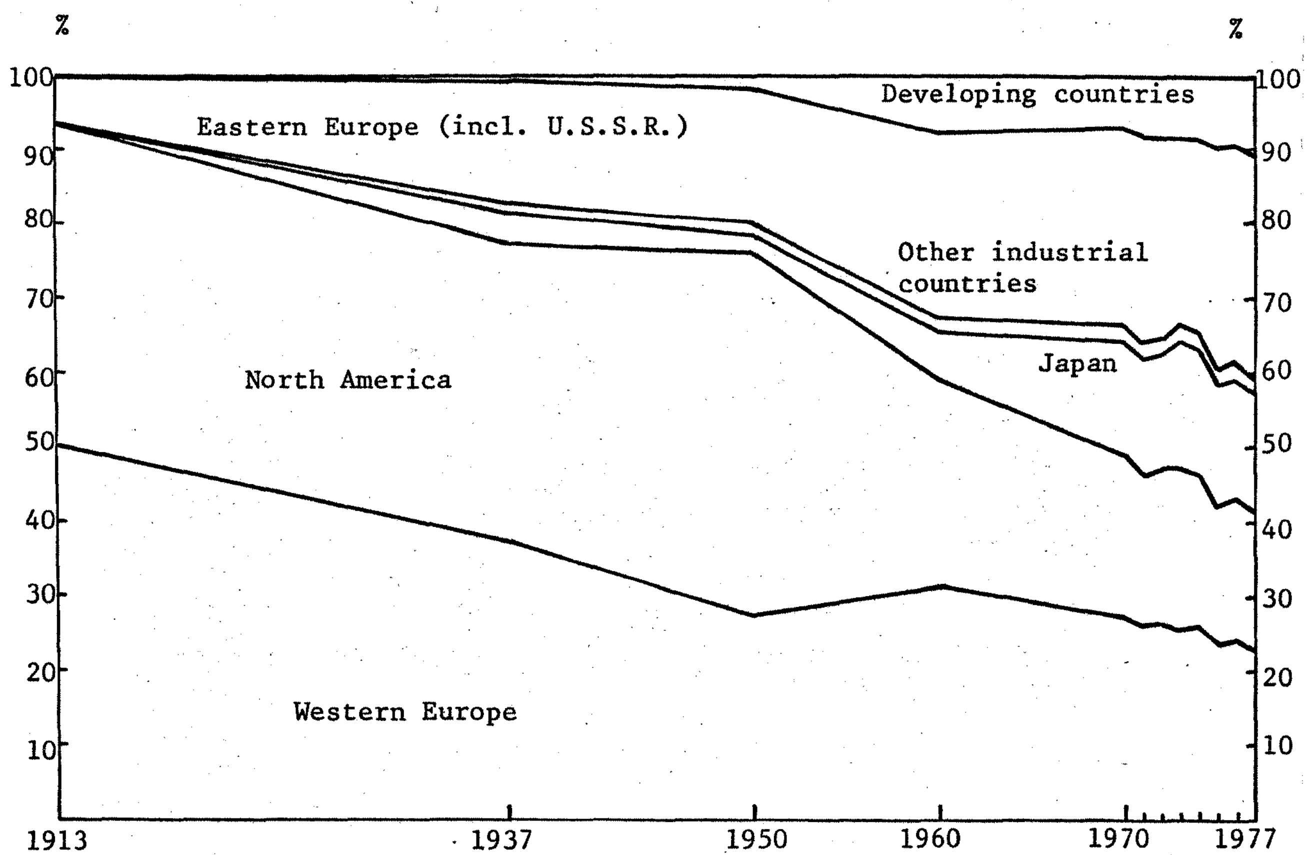
The main argument in this paper is that in an industry such as the steel industry which is characterized by very large economies of scale which increase over time, international competitiveness of a given country is directly dependent on the relative age and size structure, i.e. the relative modernity, of its plant and equipment. In combination with relatively slow growth of demand for steel in the mature industrial countries, this leads to technological decline in steel in these countries relative to newly industrializing countries. The United States and the United Kingdom seem to be prime examples of this, but it seems to be true also of Sweden and France. The relatively poor technical performance in these countries does not necessarily indicate mismanagement, however, although that possibility cannot be entirely excluded. A more likely explanation is the relatively slow rate of growth of demand for steel in these countries.

It would be unfortunate indeed if the response to this situation were to be increased protection. Such a response would be even less desirable if the problems were due to mismanagement! Protection runs the risk of locking up resources in declining industries and makes it difficult to find room for expansion in non-protected industries.

An obvious response to declining domestic growth rates of demand for steel would be to seek markets abroad. To a large extent, this has been done by Japan, and to a smaller extent also by some West European countries, notably West Germany, Italy, and Spain. But since the most rapidly growing markets are those in the newly industrializing countries which are in the process of building up their own steel industries as part of their industrialization efforts, the export prospects do not seem too bright for the future.

The question that needs to be addressed is to what extent it is necessary for strategic reasons, military and others, to maintain a domestic steel industry in the developed countries beyond what the market would call for and make profitable. This does not mean that dumping should be allowed, but we have to be careful not to protect obsolete industries. Perhaps what is needed is protection which has a definite time limit when introduced, so that it can alleviate structural change, not preserve obsolete industrial structure.

Figure 1 World production of crude steel by region 1913-1977
Percent



Note: "Other industrial countries" includes Australia, New Zealand and South Africa. For statistical reasons, China has been omitted prior to 1960. Thus, the increase in the share of developing countries between 1950 and 1960 is attributable largely to the inclusion of China from 1960 on.

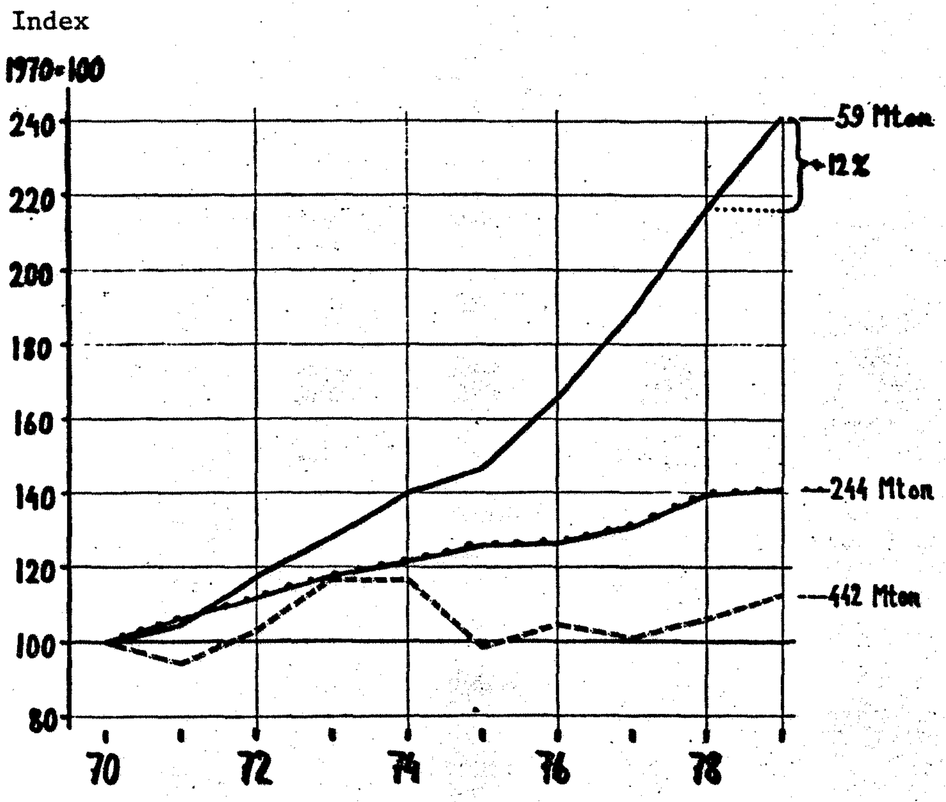
Sources: 1913-1950: (7), p. 66.
1960-1977: IISI.

Figure 2 Crude steel production by region: 1970-1979
Index 1970=100

----- Western industrial countries countries

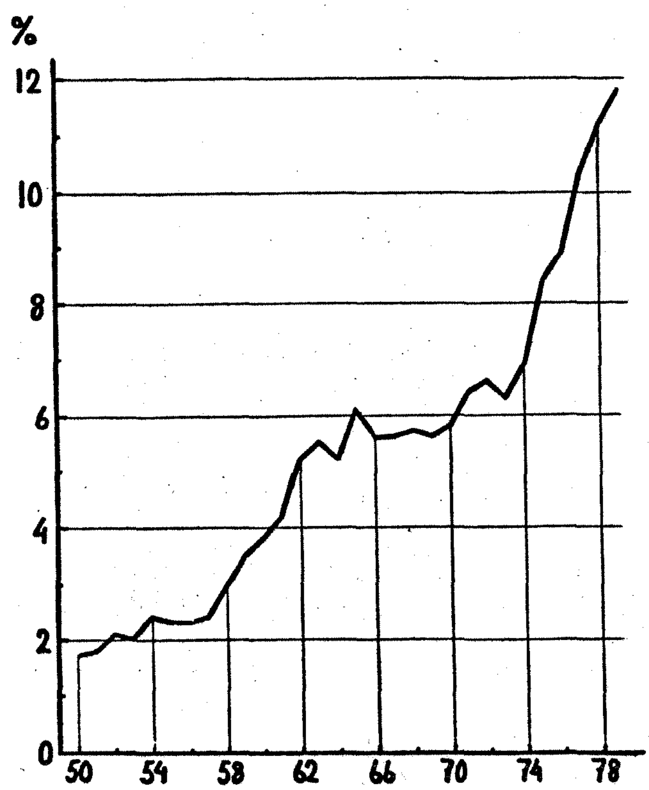
——— Developing countries

·-·-· Communist countries



Source: IISI.

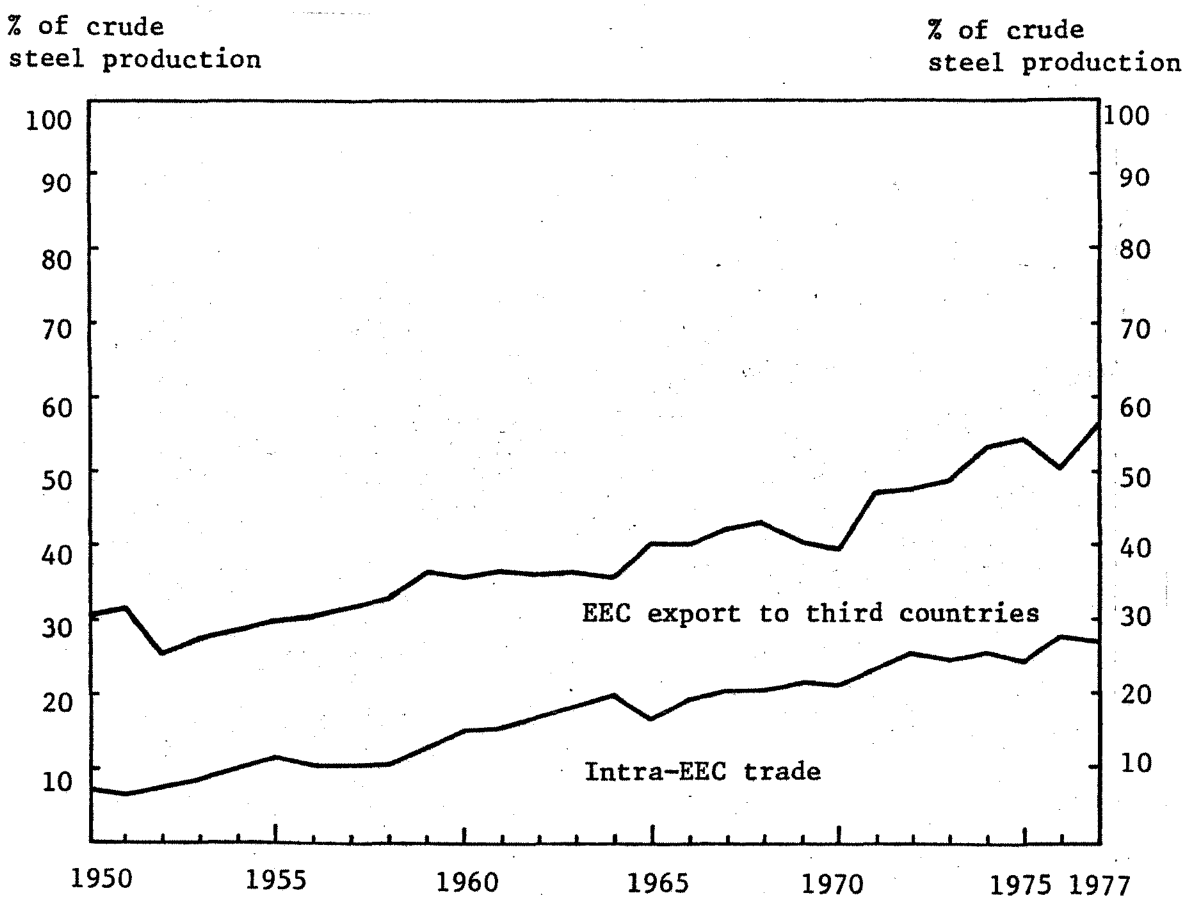
Figure 3. Crude steel production in developing countries in relation to that in Western industrial countries 1950-1979
Percent



Source: IISI.

3

Figur 4. <u>Intra-EEC trade and EEC exports to third countries in relation to crude steel production 1950-1977</u>
Percent



Note: Exports have been converted to crude steel equivalent weight by using a factor of 1.33.

Sources: (9), pp. 85 and 91; IISI.

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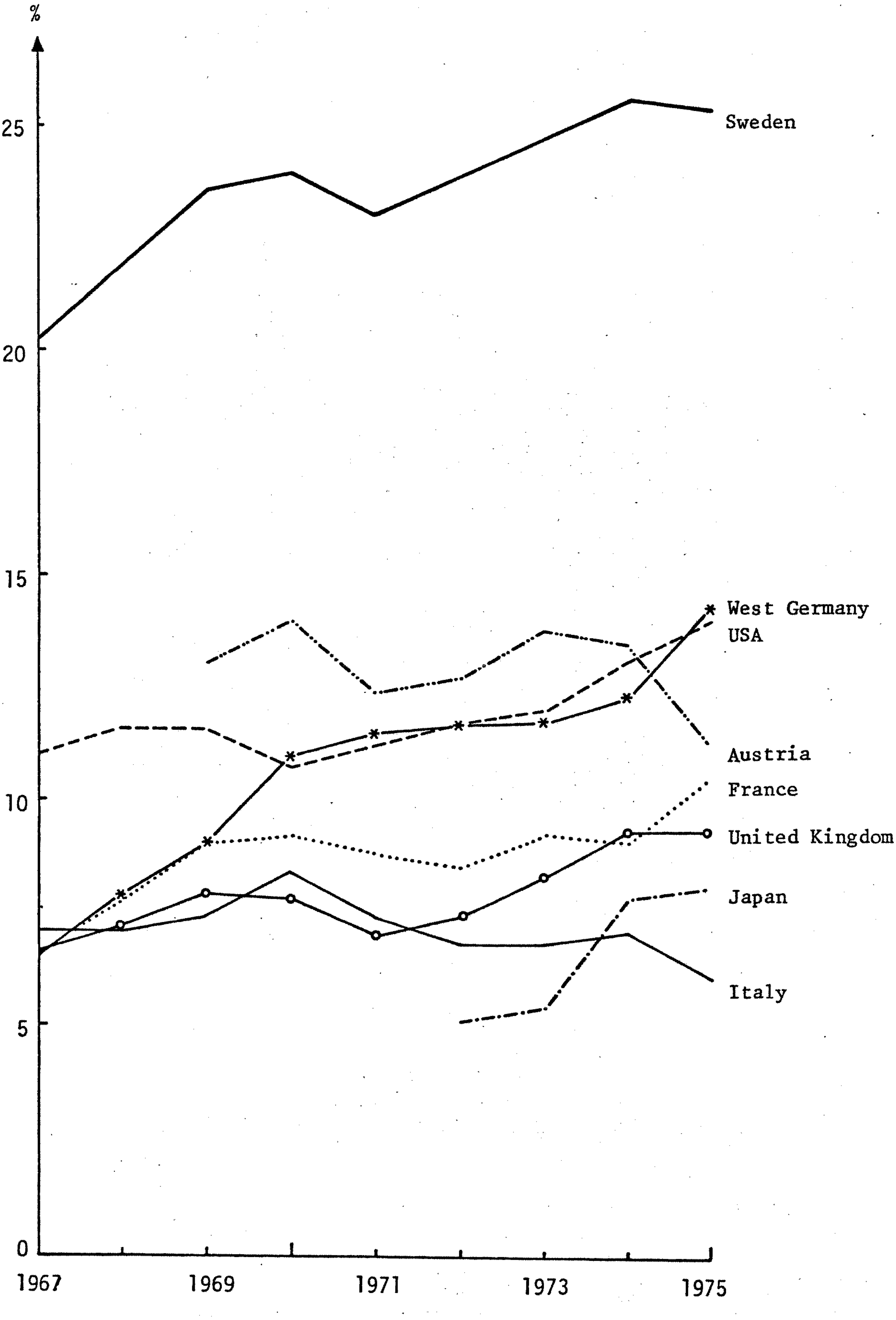
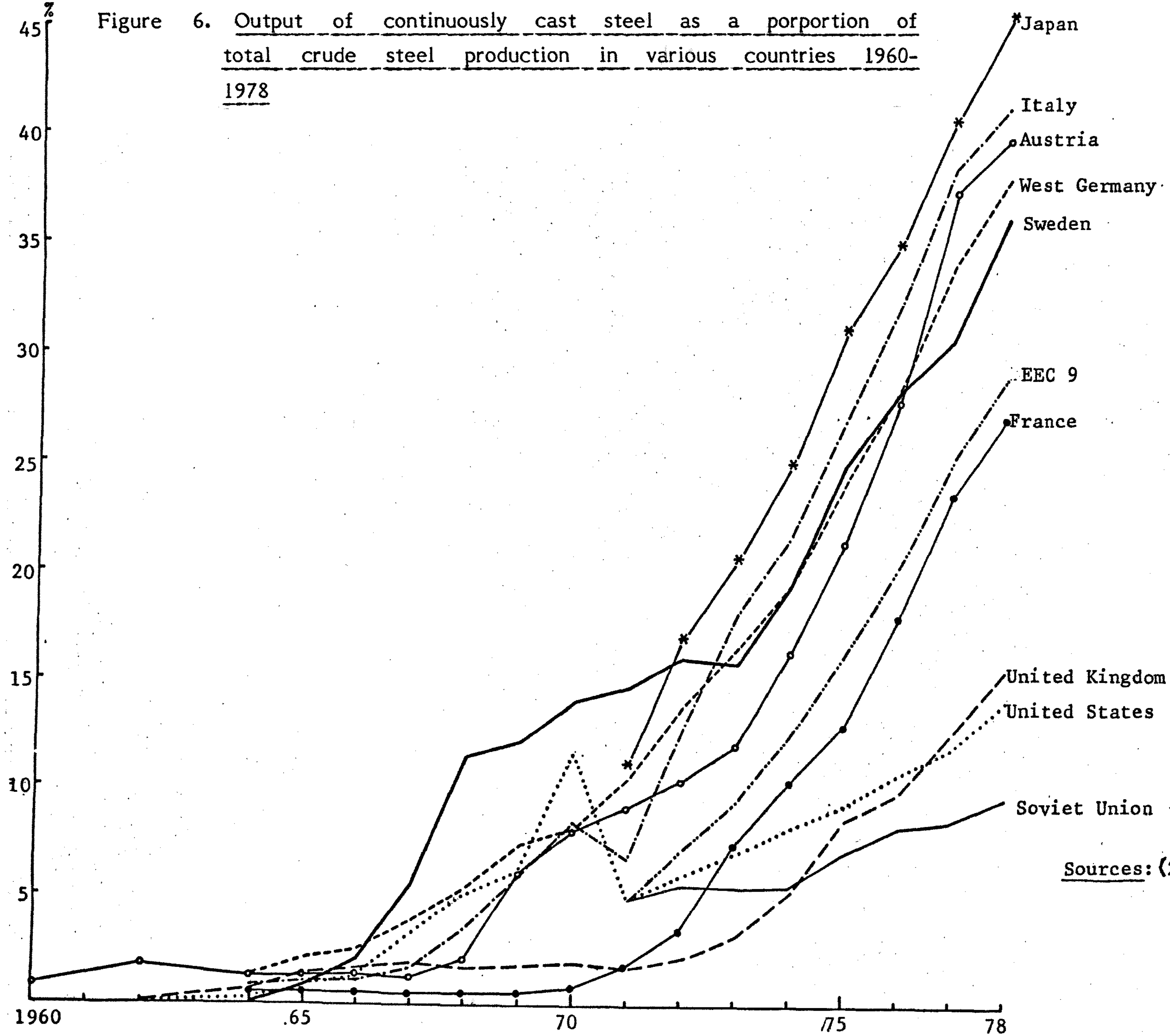
Figure 5. The share of alloyed steel in total crude steel production in certain countries 1967-1975

Percent.



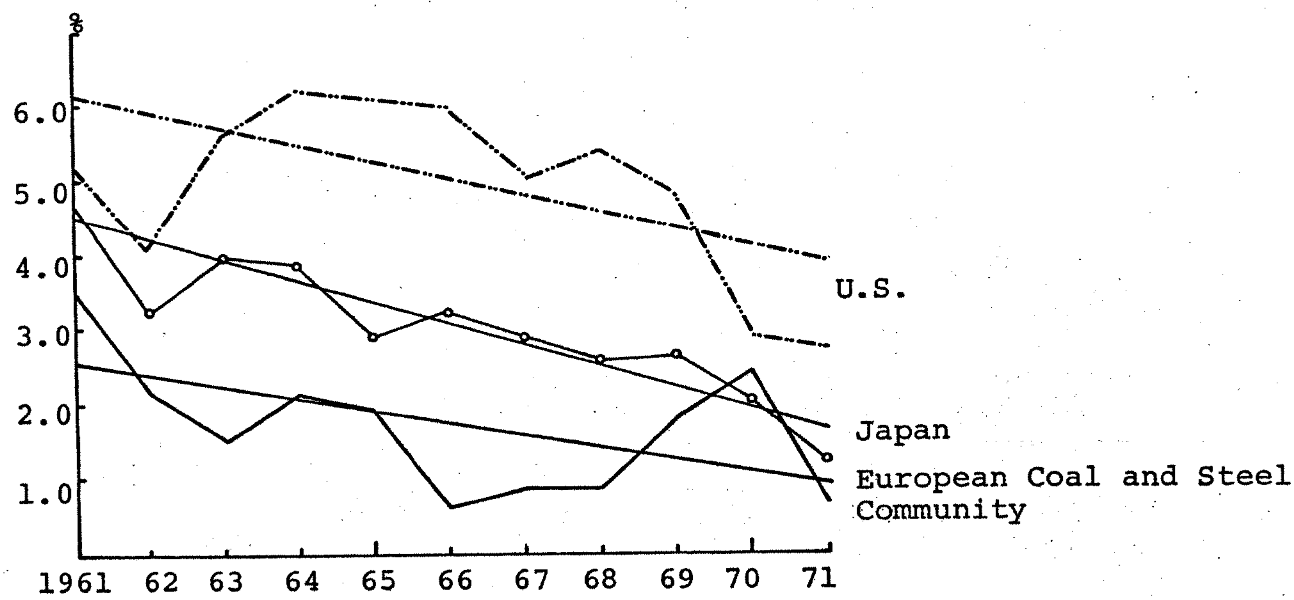
Source: IISI.

Figure 6. Output of continuously cast steel as a porportion of total crude steel production in various countries 1960-1978



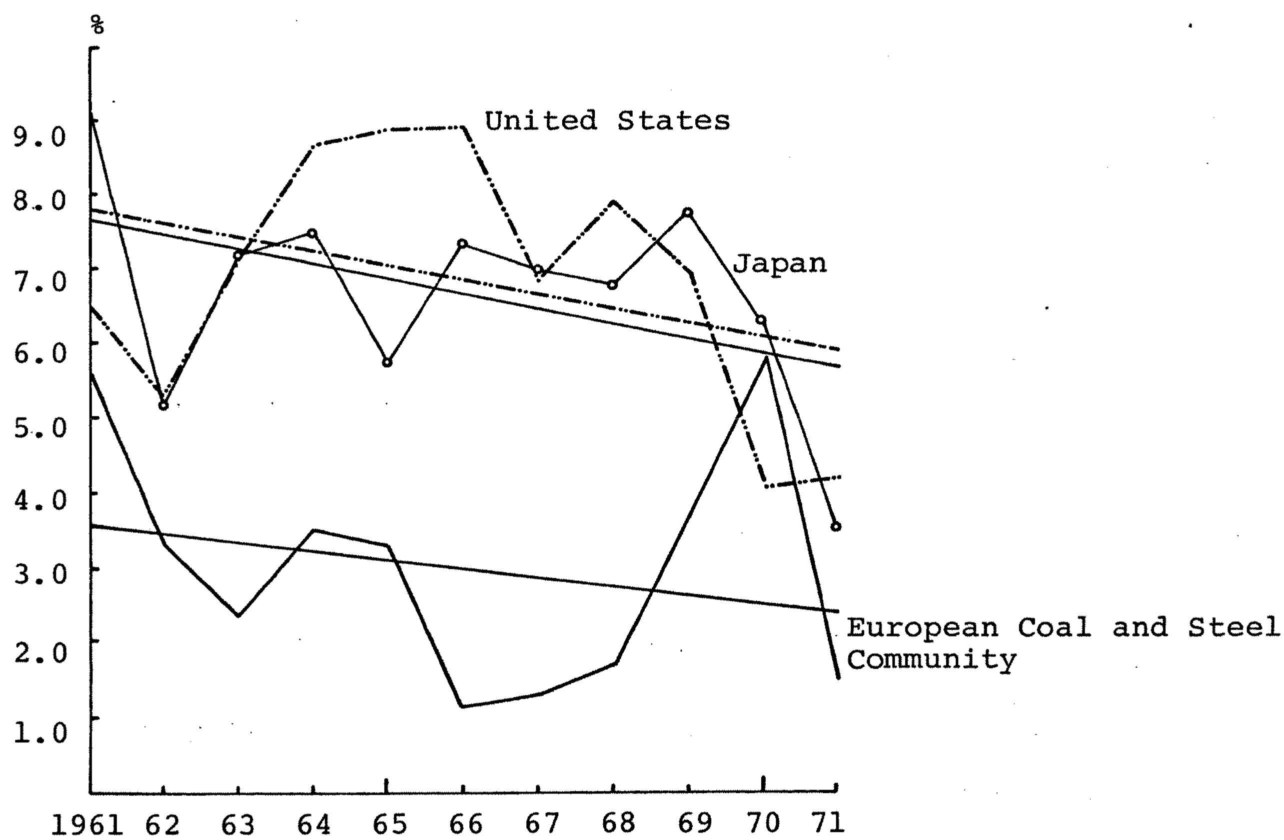
Sources: (20), p. 241; IISI.

Figur 7. Net income as a percentage of sales in the steel industries of the United States, Japan and the European Community 1961-1971



Source: (11), p. 505.

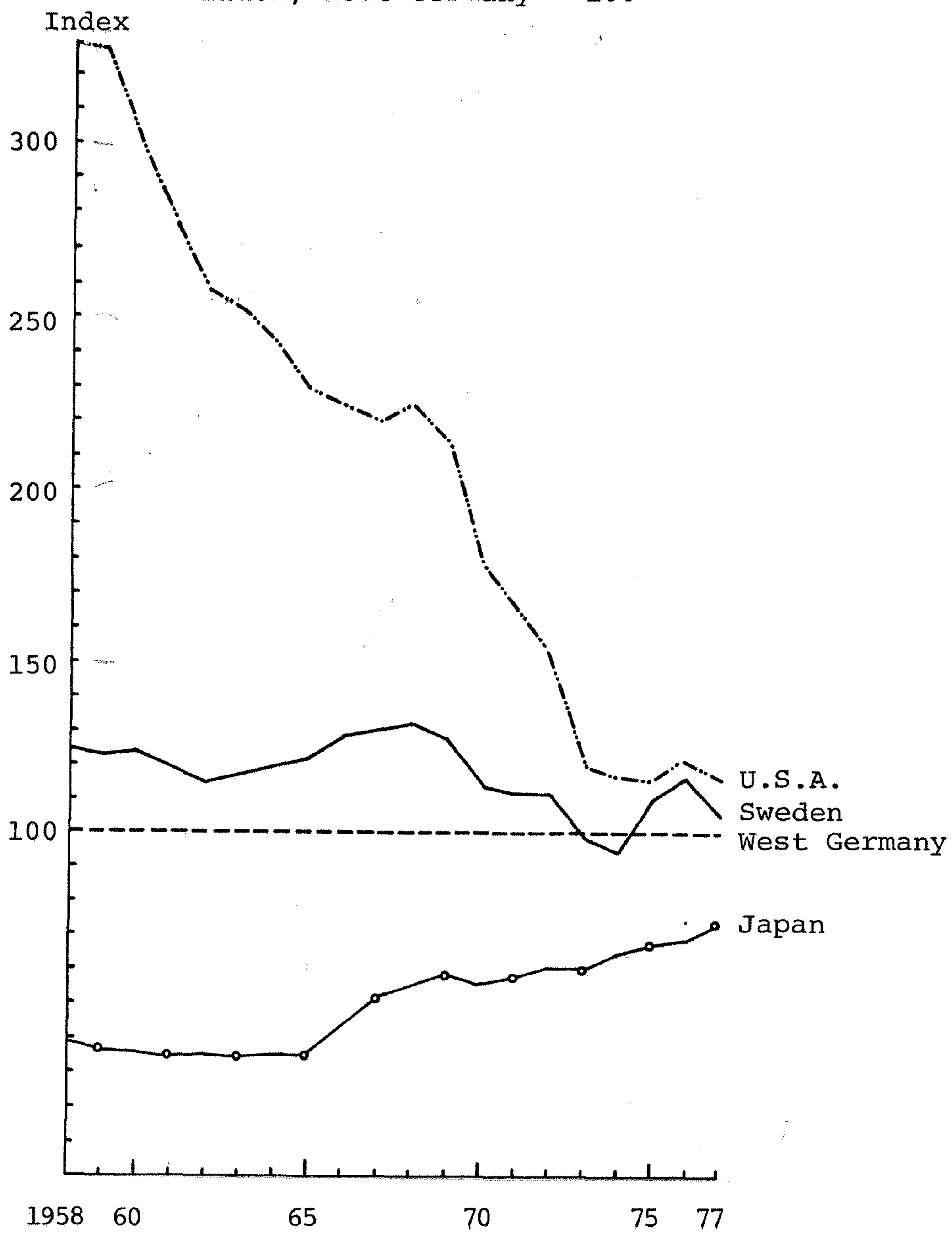
Figure 8. Net income as a percentage of equity in the steel industries of the United States, Japan and theEuropean Community 1961-1971



Source: (11), p. 505.

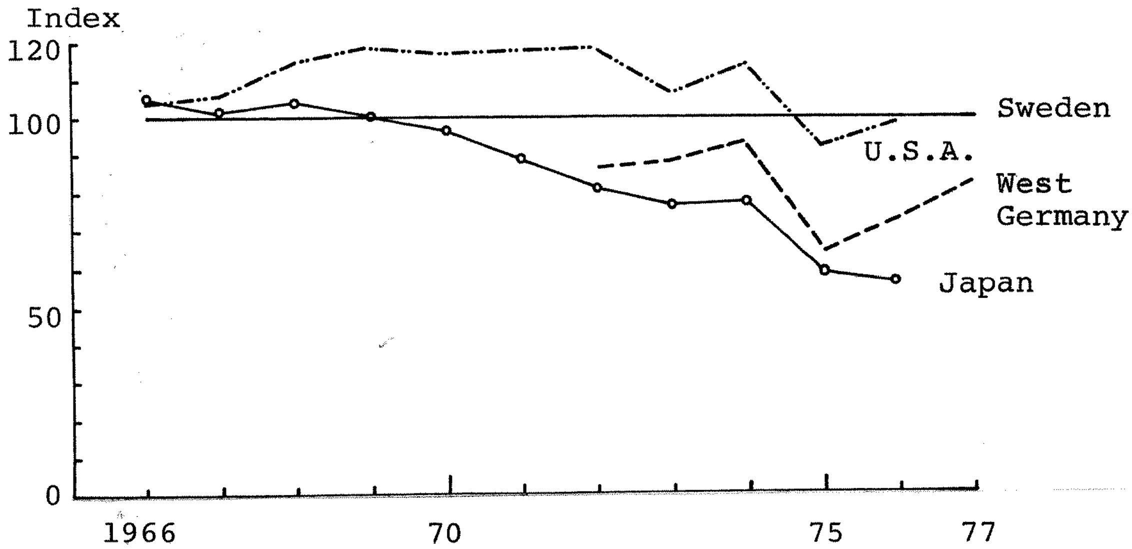
Table 9. Total wage per hour worked in the U.S., Japan, Sweden and West Germany 1958-1977

Index, West Germany = 100



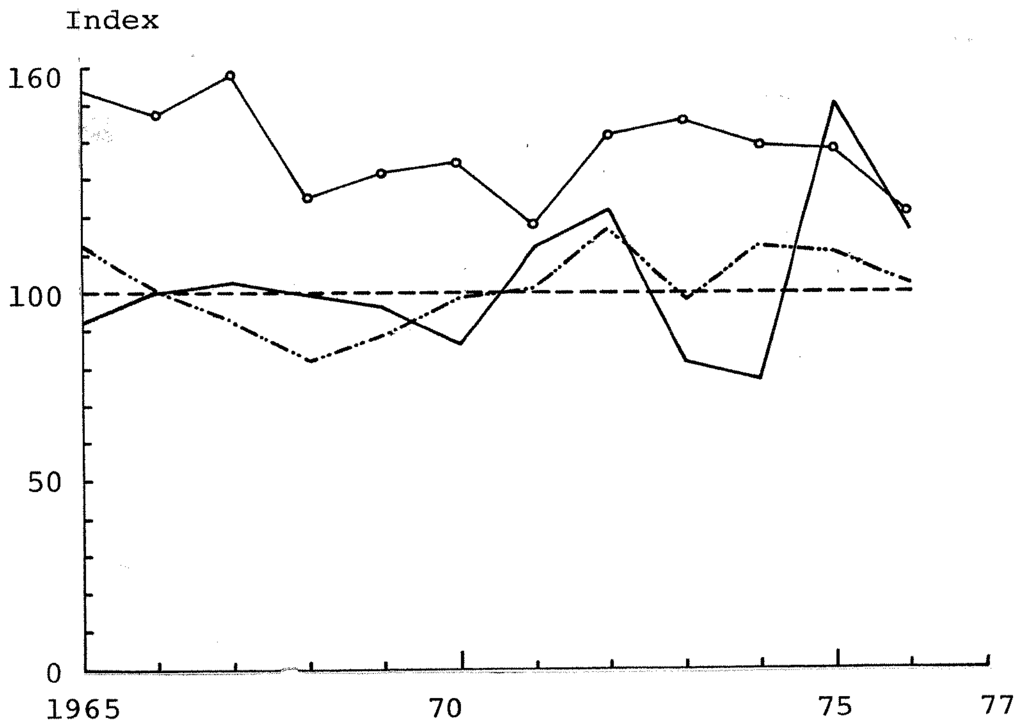
Sources: See Appendix.

Figure 10. Price of iron ore per ton in the U.S., Japan, Sweden and West Germany 1966-1977
Index, Sweden = 100



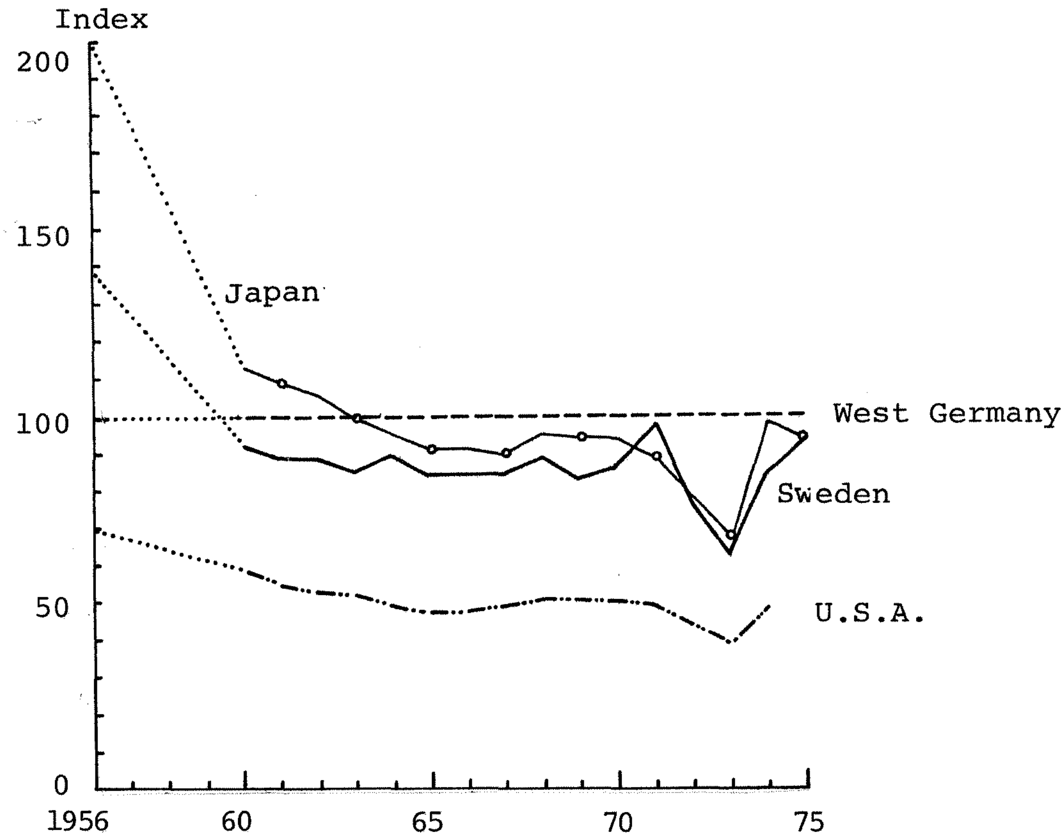
Sources: See Appendix.

Figure 11. Price of scrap per ton in the U.S., Japan, Sweden and West Germany 1965-1976
Index, West Germany = 100



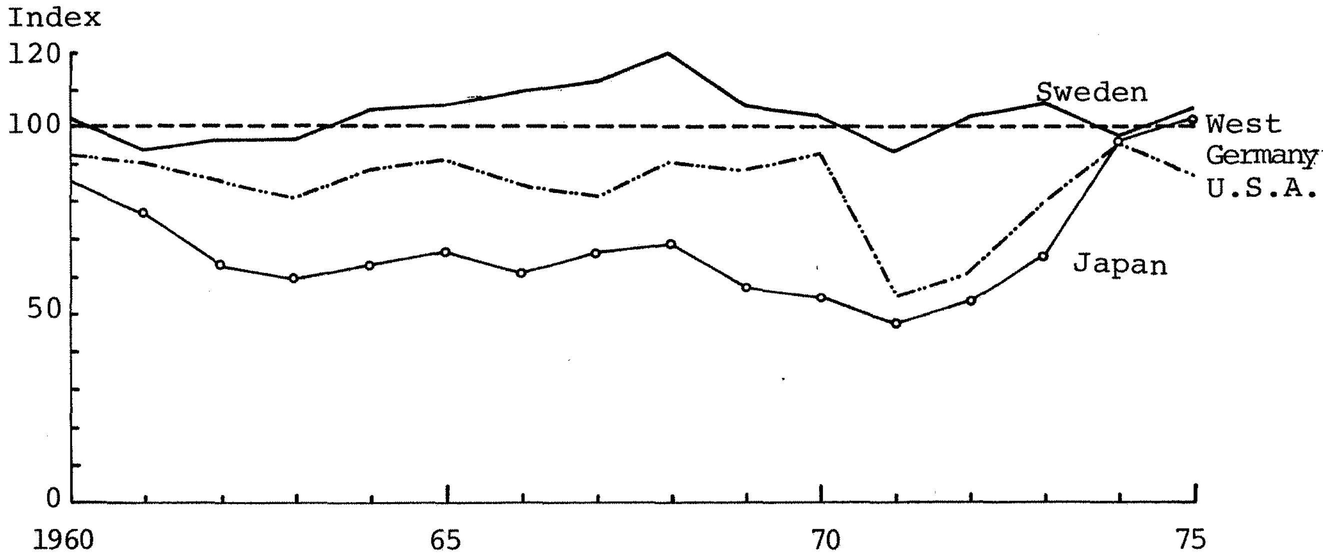
Sources: See Appendix.

Figure 12. <u>Price of coaking coal per ton in the U.S., Japan, Sweden and West Germany 1956-1975</u>
Index, West Germany = 100



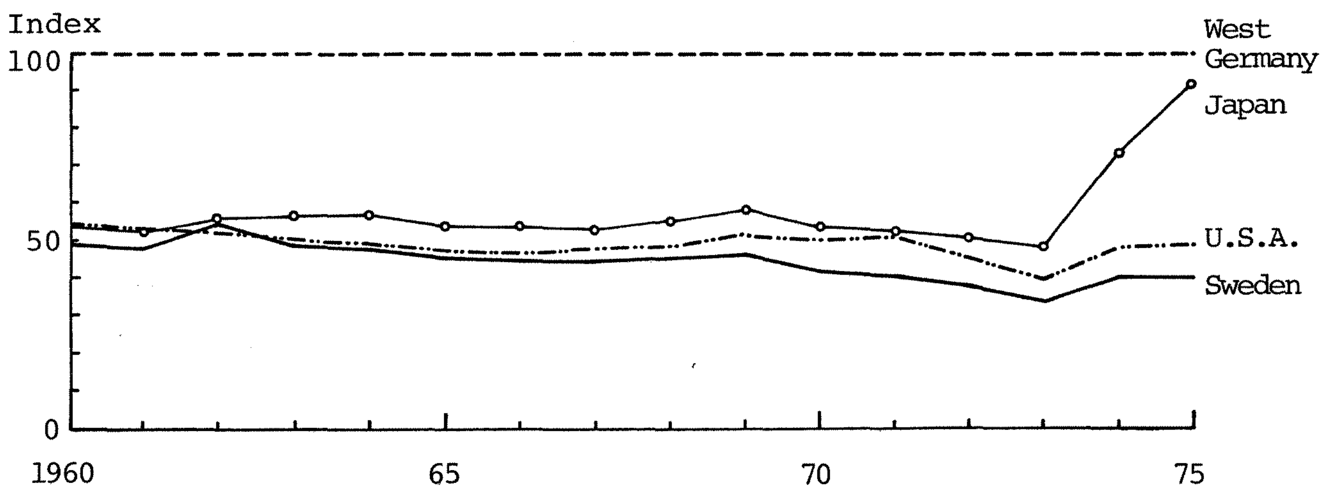
<u>Sources</u>: See Appendix.

Figure 13. Price of heavy fuel oil in the U.S., Japan, West Germany and Sweden 1960-1975



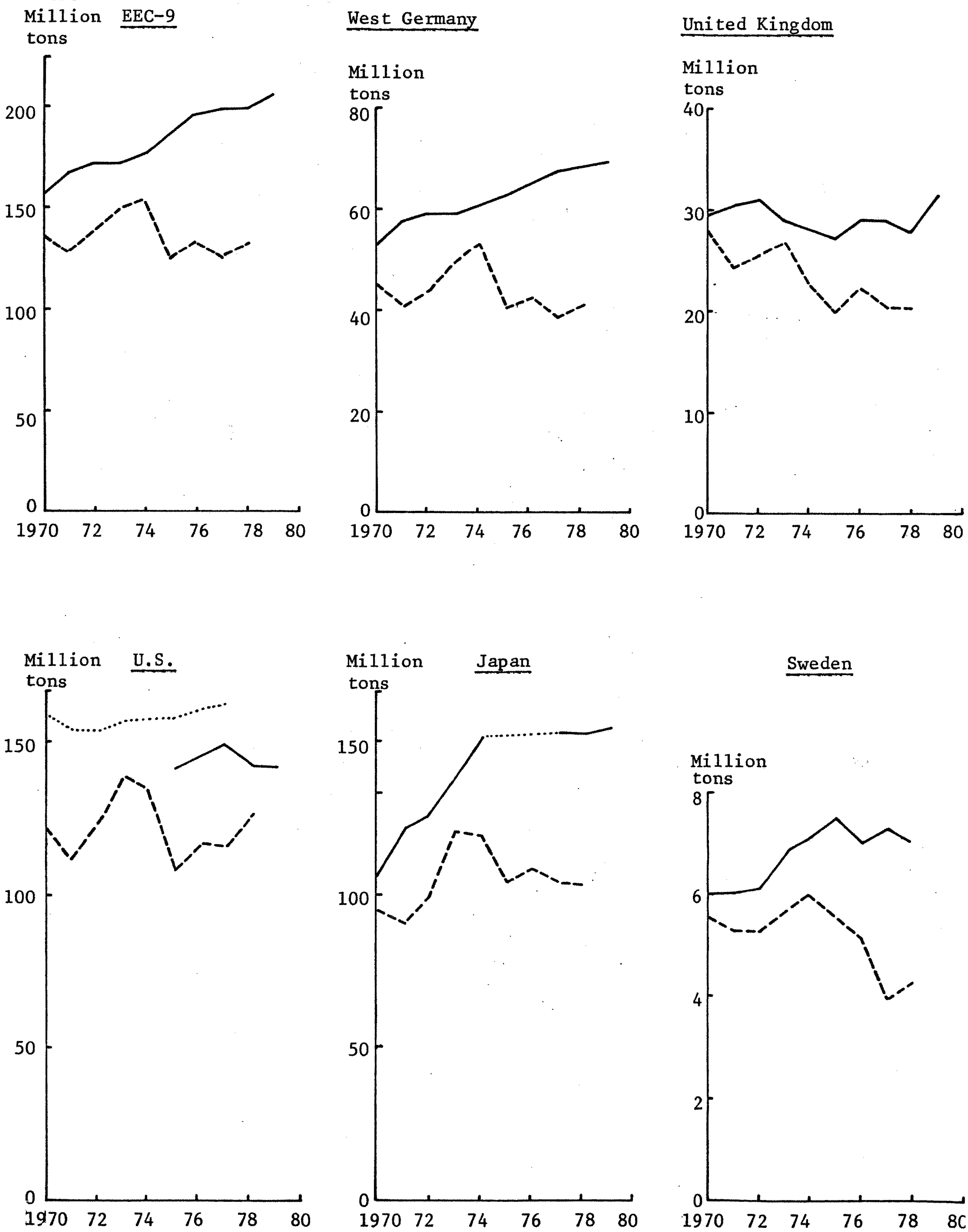
Sources: See Appendix.

Figure 14. Price of electric power in the U.S., Japan, Sweden and West Germany 1960-1975
Index, West Germany = 100



Sources: See Appendix.

Figure 15. Crude steel capacity and crude steel production in certain countries 1970-1978



Source: Swedish Iron Masters' Association, based on OECD data.

Table 1. The World's Largest Steel Producing Countries 1974 and 1978

(Million tons crude steel production)

	1978		1974	
	Rank	Million tons	Rank	Million tons
Soviet Union	1	151.4	1	138.2
USA	2	124.0	2	132.2
Japan	3	102.1	3	117.1
Fed.Rep.of Germany	4	41.3	4	53.2
People's Rep. of China	5	31.0[a]	6	53.2[a]
Italy	6	24.3	7	23.8
France	7	22.8	5	27.0
United Kingdom	8	20.3	8	22.4
Poland	9	19.3	10	14.6
Czechoslovakia	10	15.3	11	13.6
Canada	11	14.9	12	13.6
Belgium	13	12.2	16	7.5
Brazil	12	12.6	9	16.2
Romania	14	11.7	14	8.8
Spain	15	11.3	13	11.5
India	16	10.1	17	7.1
South Africa	17	7.8	21	5.8
Australia	18	7.6	15	7.8
German Democratic Republic	19	6.9	19	6.2
Mexico	20	6.7	23	5.1
Netherlands	21	5.6	22	5.8
Rep. of Korea (South)	22	5.0	30	1.9
Luxembourg	23	4.8	18	6.4
Austria	24	4.3	24	4.7
Sweden	25	4.3	20	6.0
Hungary	26	3.9	25	3.5
Yugoslavia	27	3.5	27	2.8
Rep. of China	28	3.4	36	0.9
People's Rep. of Korea (North)	29	3.2[a]	26	3.2[a]
Argentina	30	2.8	28	2.4
Bulgaria	31	2.5	29	2.2
Finland	32	2.3	31	1.7
Turkey	33	2.2	32	1.6
Greece	34	1.0[a]	34	0.9
Other Countries		10.6		9.2
Total		713.0		708.9

[a] Estimated figures.

Source: International Iron and Steel Institute (IISI)

Table 2. World Steel Trade as Proportion of World Steel Production 1950 1950-1977

Million metric tons crude steel equivalent

	World steel production[a] Million tons	Exports		Exports excl. intra-regional trade	
		Million tons	% of world production	Million tons	% of world production
1950	192.0	20.5	10.7	17.0	8.9
1955	270.5	34.0	12.6	24.9	9.2
1960	345.5	52.7	15.3	35.4	10.2
1965	457.0	78.5	17.2	53.1	11.3
1970	595.4	117.5	19.7	79.4	13.3
1975	645.6	147.7	22.9	104.8	16.2
1977	672.3	165.2	24.6	119.3	17.7

Note: 1.33 conversion factor used for conversion of exports to crude steel equivalent.

Source: IISI.

Table 3. Net Trade Position of Western Europe 1960-1975
Million tons in crude steel equivalents

		1960	1965	1970	1973	1975
(1)	Crude steel production	109.0	129.6	161.5	179.6	154.9
(2)	Imports from third countries[a]	2.5	3.1	12.7	9.1	9.6
(3)	Exports to third countries[a]	16.0	17.7	17.6	27.4	29.6
(4)	Apparent consumption[b]	95.5	115.0	156.6	161.3	134.9
(5)	Imports/apparent consumption, %	2.6	2.7	8.1	5.6	7.1
(6)	Exports/crude steel production,%	14.7	13.7	10.9	15.3	19.1

[a] Converted to crude steel equivalents by multiplication by conversion factor 1.3.

[b] Obtained as row (1) + row (2) - row (3).

Source: 10, Annex II, p. 27; IISI (crude steel production).

Table 4. West European Steel Trade by Region 1960-1975
Million tons of semis and finished products

	1960	1965	1970	1973	1975
Total exports	28.9	36.8	45.9	61.9	58.0
Total imports	18.5	25.6	42.2	47.9	42.6
Export to third countries	12.3	13.6	13.5	21.1	22.8
Imports from third countries	1.9	2.4	9.8	7.0	7.4
Net exports	10.4	11.2	3.7	14.1	15.4
Trade with Eastern Europe (incl. USSR)					
West European exports	2.2	1.2	2.2	5.7	7.5
West European imports	0,7	1.5	3.6	3.5	3.0
Trade with North America					
West European exports	2.1	5.6	5.4	6.6	4.0
West European imports	1.2	0.4	3.7	0.6	0.3
Trade with Japan					
West European exports	-	-	-	-	-
West European imports	-	0.4	2.3	2.6	3.8
Trade with other countries					
West European exports	8.0	6.8	5.9	8.8	11.3
West European imports	-	0.1	0.2	0.3	0.3

Source: 10, Annex II, p. 27.

Table 5. Net Imports (+) and Net Exports (-) of Semis and Finished Steel Products of West European Countries 1960-1975
(thousand tons of crude steel equivalent, conversion factor 1.33)

Region and country	1960	1965	1970	1975
Western Europe				
Austria	- 1 267	- 1 121	- 1 139	- 1 850
Belgium-Luxemburg	- 8 853	-10 798	-13 288	-13 023
Denmark	+ 899	+ 1 349	+ 1 689	+ 1 255
Finland	+ 772	+ 888	+ 719	+ 409
France	- 3 590	- 3 641	- 357	- 2 992
Germany, Federal Republic, of	- 5 214	- 5 213	- 4 436	-10 157
Greece	+ 317	+ 522	+ 433	+ 590
Ireland	+ 124	+ 233	+ 274	+ 251
Italy	+ 760	- 748	+ 3 836	- 4 058
Netherlands	+ 1 329	+ 824	+ 638	- 317
Norway	+ 491	+ 695	+ 1 059	+ 1 107
Portugal	+ 403	+ 418	+ 511	+ 606
Spain	- 336	+ 2 610	+ 1 185	- 1 185
Sweden	+ 882	+ 558	+ 403	+ 717
Switzerland	+ 1 310	+ 1 698	+ 2 453	+ 1 245
Turkey	+ 331	+ 408	+ 388	+ 1 062
United Kingdom	- 2 644	- 4 465	- 2 777	+ 1 342
Yugoslavia	+ 260	686	+ 1 197	+ 1 463
Other countries	+ 39	+ 178	+ 148	.
Total	-13 442	-14 945	- 6 548	-20 980

Source: 10, Annex II, p. 30.

Table 6. Number of Integrated Steel Enterprises and their Size Distribution in Certain Countries 1960 and 1975

Country	Year	Total number	Thereof with an annual production of (thousands of tons) 100	100-500	500-2 000	2 000-5 000	5 000-10 000	10 000
Benelux	1960	12		3	7	2		
	1975	10		1	4	4	1	
France	1960	14	1	3	7	3		
	1975	11		3	4	2	2	
Italy	1960	3		1	2			
	1975	3		1	1			1
United Kingdom	1960	14		3	7	4		
	1975	2			1			1
West Germany	1960	17	1		8	8		
	1975	11			3	2	5	1
EEC 9	1960	60	2	10	31	17		
	1975	37		5	13	8	8	3
Sweden	1960	3	1	1	1			
	1975	3			3			
Austria	1960	2			2			
	1975	1				1		
Canada	1960	4		3	1			
	1975	4			1	2	1	
USA	1960	21						
	1975	20			9	4	5	2
Japan	1960	9		2	4	2	1	
	1975	8			2	1	1	4
Soviet Union	1960	26		8	10	7	1	
	1975	27		4	6	8	7	2
Poland	1960	8		5	3			
	1975	8		1	6		1	

Source: 10, p. 101.

Table 7 Number of specialty steel-plants and their size distribution in certain countries 1975.

	Total number	thereof with an annual production of (thousand tons)			Average output thousand tons
		100	101-500	501-2 000	
Benelux	5	4	1	-	..
France	28	17	10	1	77
Italy	21	15	5	1	63
United Kingdom	35	29	6	-	51
Sweden	19	14	5	-	74
Austria	6	5	1	-	75
Canada	2	1	1	-	..
USA	47	37	4	6	315
Japan	..	..	9	3	..
Soviet Union	8	1	4	3	..
Poland	5	1	3	1	..

[a] Refers to 1973.

Sources: 10, pp 15-19; IISI.

Table 8. Raw iron production, number of blast furnace and blast furnace size in certain countries, 1960 and 1975

	Year	Raw iron production M tons	Total no of blast furnace	Of which with effective volume of < 1 200 m3	1 200–2 000 m3	2 000–2 800 m3	> 2 800 m3	Average output per blast furnace
Belgium-Luxembourg	1960	11,6	83	82	1	–	–	123,3
	1975	17,2	31	23	8	–	–	418,0
France	1960	14,1	147	147	–	–	–	96,2
	1975	17,9	80	68	11	–	1	224,0
Italy	1960	2,7	13	12	1	–	–	206,4
	1975	11,3	18	10	3	4	1	630,5
United Kingdom	1960	16,0	110	97	13	–	–	145,6
	1975	12,1	53	31	22	–	–	285,4
West Germany	1960	25,7	156	152	4	–	–	165,0
	1975	30,1	82	60	17	4	1	366,7
EEC 9	1960	70,1	509[a]	490[a]	19[a]	–[a]	–[a]	135,2[a]
	1975	88,6	264[a]	192[a]	61[a]	8[a]	3[a]	319,3[a]
Sweden	1960	1,4	29[b]	29	–	–	–	49,9
	1975	3,3	15	14	1	–	–	220,0
USA	1960	61,1	ca 260	..	..	..	..	ca 235
	1975	72,5	196	..	..	..	..	369,9
Japan	1960	11,9	34	30	4	–	–	349,9
	1975	86,9	51	9	14	14	14	1 703,5
Soviet Union	1960	46,7	120	80	39	1	–	389,3
	1975	102,9	136	64	60	8	4	757,1

[a] Excl the Netherlands, Denmark and Ireland.

[b] Includes charcoal-based blast furnaces. In 15 coal-based furnaces, the average output was 82,500 tons.

Sources: 10, pp. 57-61; 12A, pp. 59 and 61; 12, 1960 and 1975.

Table 9. Crude steel production by process in various countries 1978

	Crude steel production mill.tons	Steel furnaces, %				
		Basic oxygen	Open hearth	Electric	Thomas, etc.	Total
Belgium-Luxembourg	23,0	96,2	-	3,8	-	100,0
France	22,8	78,2	2,0	15,1	4,7	100,0
Italy	24,3	43,2	6,2	50,6	-	100,0
United Kingdom	20,3	55,8	8,7	35,5	-	100,0
West Germany	41,3	74,6	11,0	14,4	-	100,0
EEC 9	132,5	69,8	6,5	22,8	0,8	100,0
Sweden	4,3	48,9	7,9	43,1	-	100,0
USA	124,0	61,1	15,6	23,3	-	100,0
Japan	102,1	78,1	-	21,9	-	100,0
Soviet Union	151,4	28,1	61,3	10,0	0,7	100,0
World total	655,5	54,5	25,0	20,2	0,3	100,0

Source: IISI.

Table 10. Crude steel production by process in various countries 1965

	Crude steel production mill.tons	Steel furnaces, %				
		Basic oxygen	Open hearth	Electric	Thomas, etc.	Total
France	19,6	13,1	24,4	9,0	53,5	100,0
Italy	12,7	22,0	40,6	37,4	-	100,0
United Kingdom	27,4	20,2	63,7	12,7	3,4	100,0
West Germany	36,8	19,1	42,9	8,5	29,5	100,0
Sweden	4,7	21,8	32,3	38,1	7,8	100,0
USA	119,2	17,4	71,5	10,5	0,6	100,0
Japan	41,2	55,0	24,7	20,3	-	100,0

Sources: 12 and 17.

Table 11. Number of oxygen converters and average output in certain countries 1960 and ca 1975

	Year	1960			Mid 1970's		
		No. of oxygen converters	Total production 1 000 tons	Average output per converter	No. of oxygen converters	Total production 1 000 tons	Average output per converter
Austria	1973	7	1 773	253	9	3 016	335
Belgium	ca 1974	-	-	-	23	13 200[a]	626[a]
France	1973	3	84	28	41	13 143	320
Italy	1975	-	-	-	14	9 991	714
United Kingdom	1973	1	113	113	30	12 616	420
West Germany	1973	3	863	288	46	33 596	730
Sweden	1975	2	126	63	10	2 430	243
USA	1975	12	3 035	253	86	65 137	757
Japan	ca 1974	15	2 635	176	92	95 880	1 042
Czechoslovakia	1975	6	..	..	5	3 419	684
Poland	1975	-	-	-	3	3 356	1 119

Sources: 10, p. 72; 10, Annex II, pp. 6-7; 12 various issues; 17, p. 64.

Table 12. Average annual output of electric steel furnaces in various countries 1960 and 1975 1975.
1 000 tons

	1960	1975
Belgium	24,5	51,8
Luxembourg	16,2	12,8
France	12,3	29,3
Italy	..	27,8
United Kingdom	5,3	13,6
West Germany	12,9	28,2
Sweden	15,1	22,7
USA	25,2	71,9
Japan	7,1	25,0

Source: 10, Annex II, pp. 6-7.

Table 13. Energy (electricity and fuels) consumption per ton of crude steel in certain countries 1960, 1970 and 1978.

Kg of coal equivalents/ton at crude steel

	1960	1970	1978
France	..	771	..
United Kingdom	998	874	856[a]
West Germany	345	832	609
Sweden	711	669	656[a]
USA	990	869	795
Japan	758	572	556

[a] Refers to 1977.

Source: 18, table 18.

Table 14. Ranking of technical performance of the steel industry in certain countries

Country	Blast furnace size (1)	Share of open hearth (2)	Size of oxygen converters (3)	Continous casting (4)	Energy consumption (5)	Total technical performance average* (6)	Growth rate of crude steel output 1960-1974. %/year (7)	
Belgium-Luxembourg	4	1	5	..	..	3,3	5,1	(4)
France	8	3	6	5	4	5,2	3,2	(6)
Italy	3	4	4	2	..	3,2	7,9	(2)
United Kingdom	7	6	..	6	6	6,2	-0,7	(9)
West Germany	6	7	3	3	2	4,2	3,2	(6)
Sweden	9	5	7	4	3	5,6	4,5	(5)
United States	5	8	2	7	5	5,4	2,8	(8)
Japan	1	1	1	1	1	1,0	12,6	(1)
U.S.S.R.	2	9	..	8	..	6,3	5,4	(3)

*Note: The figures in this column have been obtained by adding the figures in columns 1-5 and dividing by the number of entires.

Sources: Tables 8-13; figure 8.

Table 15. Total employment and labor productivity in the steel industry in certain countries 1974

	IISI statistics			U.N. statistics				
	Total no of employ-ees. Thou-sands	Crude steel produc-tion. Mill. tons	Labor produc-tivity. Tons/ empl.	No. of persons engaged. Thou-sands	Value added Billion U.S. dollars	Value added/ person engaged. $ 1 000/ person	Total wage cost per hour (US$)	Index of unit labor cost (col.6/ col.7 Jap.=1(
Belgium	64,0	16,2	253	110[a]	2.29[a]	20.8[a]	6,63	139
Luxembourg	23,1	6,4	277	25	0,66	26,0	..	..
France	157,6	27,0	171	234[b]	4,89[b]	20,9[b]	...	
Italy	95,6	23,8	249	241	4,32	17,9	4,89	117
United Kingdom	194,3	22,4	115	403	4,88	12,1	2,59	91
West Germany	232,0	53,2	229	753[a]	16,43[a]	21,8[a]	7,01	139
Netherlands	24,7	5,8	235	..	..	..	6,22	..
EEC 9*	791,3	154,8	196	1 766	33,47	18,9	..	..
Austria	44,0	4,7	107	65	0,86	13,3	..	..
Sweden	50,0	6,0	120	57	1,36	23,8	7,37	135
USA	512,4	132,2	258	881	25,50	28,9	9,08	135
Japan	459,0	117,1	255	533	10,65	20,0	4,68	100

a Includes non-ferrous metals.
b Includes iron ore mining.

* Includes only the listed countries.

Sources: IISI; 21; 22 (official exchange rates); 23, p. 41.

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