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COLLUSIVE AGREEMENTS IN THE INTERNATIONAL COPPER MARKET

by

MAXIMO ANTONIOLETTI RUIZ

This thesis is submitted to the Board of Studies for Technological Economics in part fulfilment of the requirements for the Degree of Doctor of Philosophy.

University of Stirling  
September, 1979

Awarded Feb. 1980



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ABSTRACT

The study deals with the collusive agreements in the international copper market to determine the possibility of success of a producers' stabilization scheme from a historical perspective.

The research relies on the assumption that the operational conditions, the structure, behaviour and performance of an industry are in continuous interaction and by examining the relevant variables included in those concepts it is possible to make a general assessment.

The study analyses fourteen policies orientated to influence the prices of copper; six of them carried out before the First World War; three undertaken in the inter-war period, and five after the Second World War (among which a successful action organised by the major importing nations is included). However, the emphasis of the study is given to the analysis of the period 1950-77.

The word collusion has been used without any ethical, legal or moral connotation. It only refers to the ability of the producers to coordinate their decisions in those markets in which sales are highly concentrated in few producers, determining that the actions of the sellers are interdependent since the decisions of each of them have considerable repercussions on the rivals.

The general conclusion is that the structure of the international copper market has become less concentrated and increasingly complex making more difficult the operation of any producers' collusive agreement. The current policies implemented by the governments of the major exporting nations have been creating the conditions for a more competitive and complex structure of the industry, reducing the possibility that concerted action can succeed.

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## CHAPTER 1

### THE INTERNATIONAL COPPER MARKET

#### INTRODUCTION

The developing countries are negotiating with the industrialised nations an integrated programme for commodities in order to stabilise their prices and to increase the earnings from a group of eighteen primary products. No agreement has been reached so far but possibly the already long dialogue will continue in the years to come.

These negotiations have been taking place in a period of relatively high rate of inflation and low rate of growth in the industrialised countries. Both situations have unfavourably affected those countries whose exports are basically raw materials, that is largely developing countries. The low rate of growth has reduced demand for primary products and tended to depress their prices while the inflationary pressures have increased the prices of their imports, deteriorating therefore the terms of trade and capacity to import, becoming one of the important causes of balance of payment deficits. This process has in turn shifted even more the bargaining power towards the industrialised nations.

The dialogue between poor and rich countries is useful, since it permits greater knowledge of the points of view of the parts involved. However, it is believed that to a large extent the results which will be achieved around a negotiation table will not be independent of the bargaining power of both buyers and sellers as reflected in the market. Unless political considerations demand other decisions, it is unlikely that concessions will be granted to primary exporting countries which have not demonstrated capability of combining their efforts in common objectives.

This study deals with one raw material, copper, and analyses one possible course of action: cooperative behaviour among the suppliers of the international market.

The basis of the analysis is the study of the producers' collusive agreements from a historical point of view, aiming at defining the motivations and factors which determined their implementation; their form of operation and performance, and in those cases that they collapsed the causes of their failure.

These experiences reflect the behaviour of the agents intervening in the market under different conditions, the areas of interest confrontation among the different categories of sellers and between sellers and buyers, suggesting some of the elements the producers should consider in the formulation of their policies, if an international scheme to regulate



output is decided as strategy.

Other studies have been done on collusive agreements in the copper industry, the most important in the mid 1930's (1), late 1940's (2) and 1950's (3), but it is believed that a new re-evaluation of the past must be done since another historical perspective may suggest the importance of other factors, especially on a subject about which there are confronted political and economic points of view.

The study considers most of the collusive agreements reached in the international copper market, as defined later, but the emphasis is given to the analysis of the period 1950-1975. This is due to the significant changes experienced in the structure of the copper industry: a completely new group of companies took the leading position in the international copper market, changing the behaviour of the sellers relative to the historical pattern.

Another group of studies on collusive agreements were published after OPEC decided to increase the price of oil (4). These studies were prepared when the prices of most of the raw materials had experienced a significant increase as a result of the high rate of growth of the market economies, speculative manoeuvring induced by world wide inflation, rate of exchange adjustment and expectations of a process of general cartelization in other raw materials. This in turn, was caused by the

- 
- (1) Alex Skelton: Copper in W.Y. Elliot: International Control in the Non-Ferrous Industry. New York, MacMillan, 1937.
  - (2) U.S. Federal Trade Commission: Report on the Copper Industry. Washington: Government Printing Office, 1947.
  - (3) O.C. Herfindahl: Copper Costs and Prices: 1870-1957. Baltimore, John Hopkins Press, 1959.
  - (4) As examples of the long list of articles on this subject can be mentioned:
    - P. Streeten: The Dynamics of the New Poor Power; M. Radetzki: The Potential for Monopolistic Commodity Pricing by Developing Countries: in G.K. Helleiner: A World Divided. Cambridge University Press 1976.
    - D.A. Beloff, J.J. Frantz, L.H. Richmond: Nonfuel Mineral Cartels - U.S. Economic Policy and Changing World Resources Patterns. Law and Policy in International Business. V7, No.3, 1975, pages 383-903.
    - J. Tumliir: Salvation Through Cartels? On the Revival of a Myth. The World Economic, Vol.1, No.4, 1978, pages 385-395. R.K. Mikesell: More Third World Cartels Ahead? Challenge. November-December 1974, Vol.17, pages 24-31. C.F. Bergsten: The New Era in World Commodity Markets. Challenge. September-October 1974, pages 34-42.
    - A. Edwards: The Potential of New Commodity Cartels. The Economist Intelligence Unit, QER Special No.27, 1975.

euphoria that the decision of OPEC had created among the raw material exporting countries: "the oil exporting nations had shown the way" not only to solve the balance of payment deficits but also to shift the political and financial bargaining power from the industrialised to the developing countries.

The large number of publications were mainly concerned with the problems which arose from the OPEC success and the threat of similar actions on the part of other mineral producing nations. Their basic objective was to identify other markets in which such action could succeed. The general conclusion of these multi-product studies, including copper, was that OPEC was a particular case and no other raw material producer was in a position to adopt a similar decision.

These studies reinforced the old principle, that the producers' strategies must be based on the institutions, technology and structure of each market. This may seem obvious but it was not either in developing or in industrialised countries immediately after the unexpected OPEC decision and in the particular conditions surrounding it.

#### 1.1 The Methodology of the Study

Economic theory distinguishes three basic market structures attending to sellers' concentration: perfect competition, oligopoly and monopoly; and according to buyers' concentration: monopsony, oligopsony and perfect competition. In each of these market structures there is a resulting pattern of inter-relations among the sellers and between buyers and sellers.

The conceptual model of this study derives from economic theory and industrial organisation. The firms exploiting an identifiable product compete as sellers to obtain a given objective. It is assumed there is a group of conditions affecting the structure of a market which in turn influences behaviour and performance of the participants in the market. Each of these concepts includes a large category of elements which are in continuous interaction but not mechanically. Moreover, not all influences flow in a unidirectional way from conditions towards performance; there are feedback effects as will be seen.

Among the group of conditions shaping the structure of an industry are the physical characteristic of the product, the technology, the features of demand (rate of growth, price and income elasticities, cyclical fluctuations) form of marketing, the legal infrastructure, government regulations and policies.

The structure of the market involves variables such as the number of sellers and buyers, buyers' and sellers' concentration, the degree of vertical integration, product differentiation, structure of cost, barriers to entry.

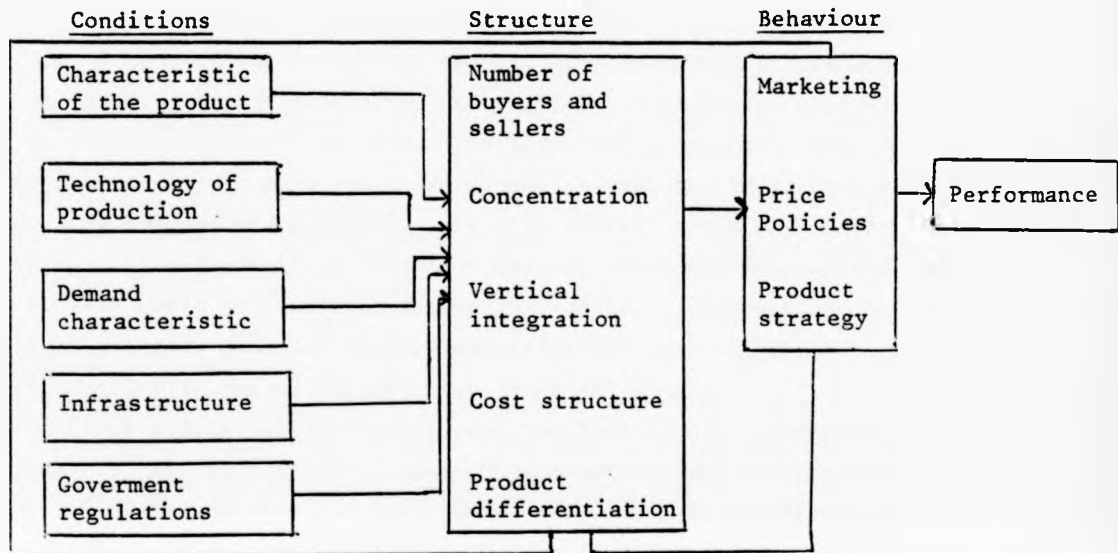
As the analysis is referred to the international market it also becomes important to define the structure of the buying and seller market by countries.

Market performance refers to the results at which the firms arrive at by maintaining a given behaviour (1). These end results include: the relative technical efficiency of production; the rate at which the industry use the opportunities opened up by science and technology to improve production.

Figure 1.1 schematically illustrates the inter relation between these concepts.

Figure 1.1

Conditions, Structure, Behaviour and Performance Inter-Relations.



The model is not rigid. Behaviour may influence production conditions or structure. For example, research and development work may alter the characteristic of the production process and hence its cost conditions; or a collusive price agreement among sellers may attract new

(1) J.S. Bain: Industrial Organisation. John Wiley & Sons Inc., 1968, page 10.

firms into the industry, thereby altering the degree of concentration.

When the international copper market is analysed on the basis of this model it is possible to measure the vigor of competition and trends in competitive behaviour as a multi-vectored dynamic process.

## 1.2 The Limits of the Study

This study considers the collusive agreements in the international copper market, defined as the segment of the world copper industry outside the U.S. and the centrally planned economies. These areas have been separated from the international market because they are basically self-sufficient. Information about the U.S. and the socialist markets is introduced to the extent that it is necessary for an understanding of the evolution of the international copper market and to define their operational inter-relations.

As the period covered by the study is long the patterns of reference experienced changes, affecting the definition of international market.

From the last decades of the last century until the early 1930's about 50 per cent of the world copper production was absorbed by the U.S.; U.S. companies controlled the technology of production at the three relevant stages of production and supplied three quarters of world consumption; except the Belgian Congo since the First World War, they had no rivals which possessed copper reserves large enough to meet the additional requirements of the dynamic world demand. In this period, there were no tariffs or barriers to trade in any relevant market, therefore there was no difference between world and international copper market. However, in the mid 1920's Canada expanded copper production and in 1931, the U.K. started mass production in one of its colonies, Northern Rhodesia.

As a result of the crisis and the fact that the companies located in the U.S. supplied the total domestic demand and the competitive advantages of the rivals of the U.S. producers, a prohibitive tariff was introduced in 1932. The world was divided in two different but inter-related markets. In the 1930's the USSR started mass production to meet its domestic demand but creating the basis of the third segment of the world industry. In 1950-75 this country supplied most of the requirements of the centrally planned economies.

So the limits of this study can be defined as the collusive agreements in the world copper industry until the 1930's and in the international market after the crisis. However, the two World War price fixing experiences are not considered due to the abnormal character of these periods.

### 1.3 The definition of Collusion

It is important to specify the meaning of the word collusion in the context of this study since most of the dictionaries associate this word with illegal or dishonest purposes. For instance, the Oxford Dictionary defines it as a fraudulent understanding, especially between ostensible opponents. In the U.S. dictionaries, and encyclopedias, apart from the fraudulent character of the understanding, secrecy is also an essential part of the definition, being substantially the same as conspiracy (Encyclopedia Americana).

In this study collusion has neither a legal nor an ethical connotation. It has the sense and meaning given in economic theory in general and the theory of oligopoly in particular. In this context collusion means cooperation among competitors. It is closely connected to coordination but not all collusive agreements achieve coordination.

Collusive agreements are typical in an oligopolistic market, that is, industries in which a small number of firms account for a large proportion of the market, so that there is a high degree of interdependence in the market decisions of the firms. The result of this feature is that each seller must predict the reactions of its rivals to determine the consequence of its decisions. Such a situation considerably increases the risk faced by the sellers. Partly because of the uncertainty and partly because the sellers may increase their profits, they tend to collude or to reach tacit or explicit understanding.

The opposite to collusion is independent action, that is, each producer makes its markets decisions without consultation with its competitor and without taking into account the possible reaction of its rivals (1). To be possible independent action, it is required that all the firms in the market are relatively small and none of them supply an

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(1) J.S. Bain: Industrial Organisation, page 273. John Wiley and Sons, 1959.

important part of the market (1) (2).

Machlup states that the question of collusion in oligopolistic competition usually is not of "whether" but "how much" (3). The absence of collusion for a long time is rather difficult to conceive in an oligopolistic market, simply because non cooperative forms of behaviour invites retaliation and the fear of retaliation invites self restraint (4). However, the degree of collusion is not static, it tends to vary either towards more cooperative or more competitive patterns of behaviour, depending on the market conditions and the structure of the industry.

Most of these concepts will be discussed again in Chapter 3, but before postponing this subject it is important to note that collusion can be either explicit or tacit. However, tacit understanding presupposes both relatively obvious objectives to all producers and also stable market conditions. Complex objectives are more difficult to attain without communication if not without a more structure system to compensate those producers which may be unfavourably affected by the implementation of a cooperative scheme. Instability may also make difficult the coordination of the decisions without clear and well defined objectives and policies.

Copper is one of the products subjected to drastic changes in the market conditions (at least in three times prices abruptly increased by more than 100% and then drastically fell to their previous levels in the next five following months). Since this instability makes tacit collusion an unrealistic alternative, the emphasis of the theoretical analysis is given to one form of collusion, the international cartel.

#### 1.4 Governments' Policies Interdependence

In developing countries exporting of copper the governments have played an important role in the industry in the last 20 years. Their

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- (1) This does not necessarily mean that collusive actions are not possible in an atomistic market but their implications may be totally different as will be seen in Chapter 3.
  - (2) An oligopolistic structure in which collusive agreements are unnecessary is that in which a large firm, controlling a significant part of the market, co-exists with a large number of small firms or competitive fringe; the relevant market decisions of the latter are subordinated to those of the large firm.
  - (3) F. Machlup. The Economic of Sellers Competition. Model Analysis of Seller's Conduct. Page 436-37. The John Hopking Press, 1952.
  - (4) F. Machlup. The Basing Point System; page 34, Philadelphia. Blakiston 1934.

policies have caused significant changes in the structure of the international copper market: five of the leading copper companies were totally or partially nationalised and the governments of four countries took over the marketing of the product. The trend was towards greater interventionism by the governments. But in 1975 the policies began to experience drastic changes of conception in these countries; their industries were not denationalised but liberal policies were introduced in the treatment of foreign investment.

The decision to nationalise were implemented in a period of international economic expansion and high level of prices while the liberal policies were introduced during an economic recession and low prices. In the period of economic expansion the governments of the copper producing countries improved their bargaining position and it was easier for them to change their relations with the foreign companies. The reverse situation has tended to occur during the recession.

When the number of exporting nations is few their policies are interdependent. This concept is not new but the situation is relatively new in the copper industry. Until the 1960's Chile was the only important copper exporting country which had to deal with foreign companies; in other areas the mineral was exploited by national companies (industrialised countries) or in colonial territories.

This inter-dependence has introduced a relatively dynamic and uncertain feature to the inter-relations of the copper exporting countries: affecting both their short and long run decisions. The decisions of investment of one nation, for instance, modify the long run position of the other copper exporting countries which have to react or adjust their policies to counteract such a move, on the other side the changes of policy modify the parameters of action of the companies whose market decisions also affect the position of their rivals.

An example, based on a relatively recent situation may better define the interdependence of the governments. In 1975 the Chilean government announced probably one of the most liberal policies on foreign investment. In 1977, the first contract with a foreign copper company was negotiated and unusual tax concessions respect historical patterns were granted. In 1978 the government of Papua New Guinea improved the terms for investing in a copper deposit; Peru and Indonesia also changed their policy of investment.

Such a competition for foreign capital tends to reduce the net revenue per ton that these countries will obtain from the exploitation of their minerals, and tends to increase the bargaining power of the multinational companies involved in the negotiations.

When imports are highly concentrated in a few countries, as in the case of copper, the buyer countries may have a considerable influence on the policies of the exporting countries. Both buyers and sellers have several areas of common interests such as to avoid the adverse effects of excessive price fluctuations, to ensure the adequacy of flows of investments and the availability of the product. But their strategies include several areas of interest confrontation, for instance, importing nations are interested in diversifying their sources of supply. If such an objective is pursued by supporting the development of new sources of supply, this affects the market position of the existing producers. Vertical integration is also another area of interest confrontation: the supplying countries are interested in processing as much as possible of the product in their territory for foreign exchange, employment and value added considerations; the importing countries are interested in developing processing plants in their countries for similar considerations, but also as a mechanism of influencing the market. Both of them may well be interested on stabilizing the price but they have divergent views on the level at which such a stabilization has to be implemented and as suggested by economic theory, if there are few sellers and few buyers the price will be the result of the bargaining power.

As will be discussed in Chapter 6 and 7, if unco-operative relations are dominant among the suppliers of the international market, the result may be favourable to the buyers not only because intense competition implies lower prices but also because importers have more flexibility to implement their strategies. The reverse situation does not necessarily imply tough relations between buyers and sellers, this will depend on the objectives and policies implemented by the producers.

The negotiations, the formulation of joint policies and the operation of the international cooperative scheme have always presented difficulties in any industry. However, the difficulties involved in an understanding do not imply that the alternative option is to ignore producers interdependence. High degrees of collusion and intense competition both have a cost and a benefit for the producers, which are extraordinarily difficult



if not impossible to measure without totally arbitrary assumptions which have to ignore, in one degree or another, the interdependent character of the decision of the producers. This is an additional factor which makes important the evaluation of the collusive agreements and the periods of intense competition in a proper historical perspective.

#### 1.5 The Structure of the Study

This study is divided in four parts:

The first analyses some of the conditions determining the structure of the industry, the characteristics of the product, sources of production, reserves, the technology of the industry, and the general feature of the demand. All these factors are considered taking into account the present operational characteristic of the industry. A general description of the development of the technology of production is contained in Chapter 2 while the policies and strategies of the exporting and importing nations are included in the analysis of each of the collusive agreements.

The second part discusses theoretical subjects relevant to this study, some of the general models of the theory of oligopoly, the relation between buyers and sellers and one form of collusion, the international cartels, emphasising the character of those which have operated in the raw material markets.

The third part is referred to the structure and behaviour of the international copper market; the collusive agreements prior to the World War Two, included in Chapter 4. Chapter 5 is concerned with the structure of the industry in 1950-75, but stressing the evolution of the private segment of the industry; the separate analysis of the structure from the behaviour of the industry is due to the drastic changes in the structure which took place in a relatively short period. Chapter 6 deals with the collusive agreements in 1950-73 and Chapter 7 with the period 1974-77, including a general assessment of the Intergovernmental Council of Copper Exporting Countries (CIPEC).

Finally, in part 4 the most general conclusions of the study are drawn.

CHAPTER 2Copper: its characteristics, technology of products, uses, demand and costs

This chapter defines copper from a technical point of view, the volume of reserves and resources; the process of production and consumption of the metal are described and then an analysis of the capital and operational costs of the industry outlined. This chapter is intended to be an introduction to the analysis of the structure of the copper industry and the behaviour of the participants, but it also aims to define the inter-relation between some of the technical and economic characteristics and to define some technical problems whose solution may have important economic implications.

2.1 Technical Characteristics of the Product

Copper is the 29th element of the periodic table. It has an atomic weight of 63.54 and specific gravity of 8.96. It is non-magnetic, tough, and moderately hard, its melting point is  $1084^{\circ}\text{C}$ . The most important properties of copper are its ability to conduct electricity and heat, its corrosion resistance, good ductibility and malleability, high strength and easy solderability. Some of the properties of copper can be improved or modified by alloying it with other metals.

2.1.1 Electrical Conductivity

Because of its high electrical conductivity, copper is extensively used as a conductor in the electrical industry. This activity is the most important market for the copper industry.

Copper is the second best conductor of electricity per unit of volume of any metal, the first is silver. The third best conductor is aluminium which has 61.6% of the conductivity of copper in terms of volume. This implies that aluminium must have a greater sectional area than copper to achieve the same result.

If conductivity is measured in terms of weight, aluminium performs twice as well as copper. Relative conductivity values are given in the table below.

<u>Metals</u>	<u>Conductivity Per Cent By</u>	
	<u>Volume</u>	<u>Weight</u>
Silver	100	44
Copper	94	50
Aluminium	57	100

These different forms of measurement of electrical conductivity explain why aluminium is considered the most important competitor of copper.

### 2.1.2 Thermal Conductivity

Copper is also the second best heat conductor. It possesses about 92.8 per cent of the thermal conductivity of silver, it is about 32.5 and 94.6 per cent more conductive than gold and aluminium, respectively.

<u>Heat Conductivity of some metals: cal/cm/cm<sup>2</sup>/sec.</u>		<u>Relative percentage</u>
Silver	1.006	100
Copper	.934	93
Gold	.734	73
Aluminium	.480	48
Iron	.161	16

### 2.1.3 Other Properties

The corrosion resistance of copper can be increased when alloyed with other metals. This property, especially the resistance to oxidation while carrying water, accounts for one of the best known uses of copper in plumbing installation.

Copper can be formed into different shapes without heating. This characteristic is important since it tends to oxidize when heated. In contrast with other metals, copper is extensively plastic in deformation after substantial reduction in cross-sectional area. For instance, in wire-drawing copper is often reduced to less than 1% of the original diameter.

In terms of tons, the most important application of copper is as a pure metal. Other applications of copper are as a base alloy, as an alloying element or compound.

The objective of any alloy is to improve or produce a certain desired characteristic or property which is also affected by the process of production used to obtain the alloy, which can be classified in two groups: wrought and casting alloys.

## 2.2 Sources of Supply

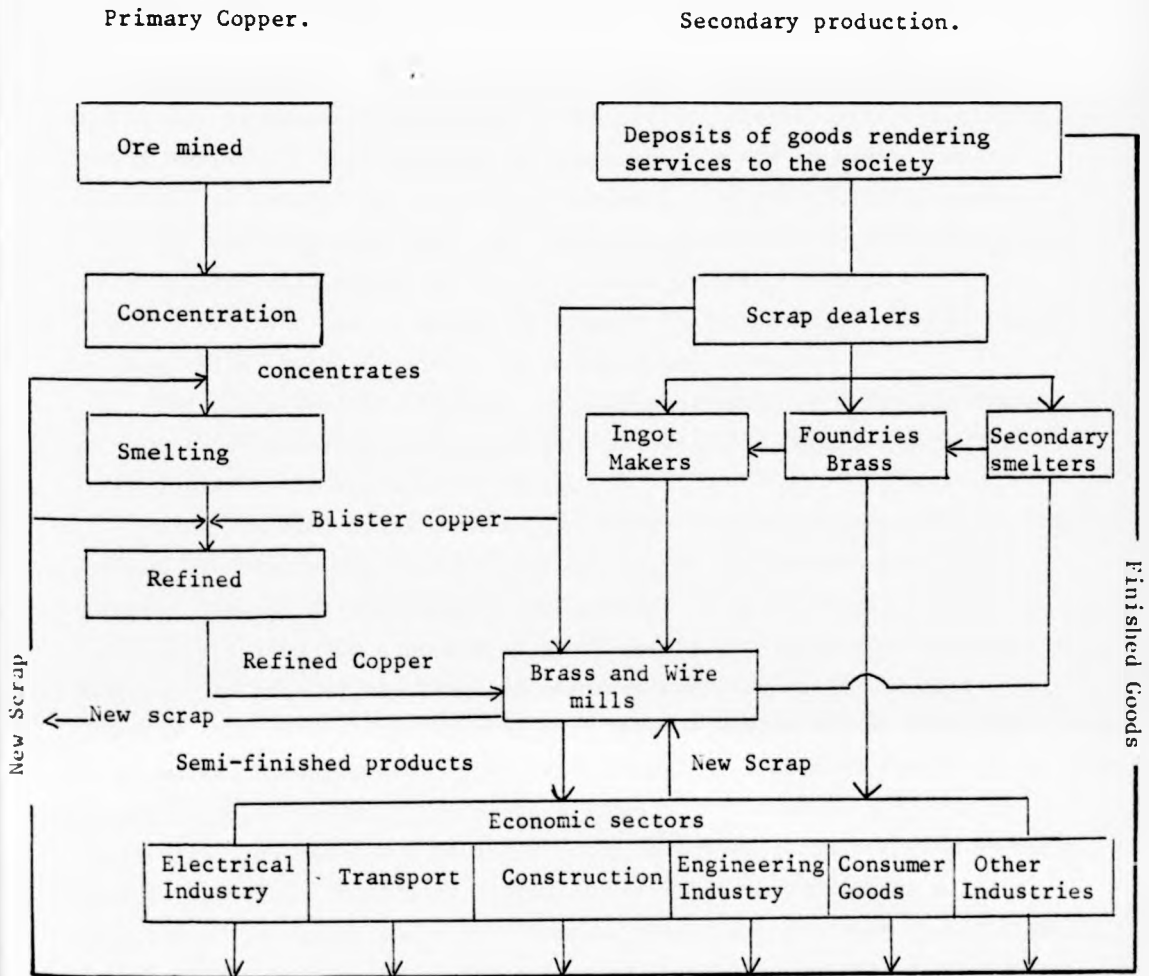
There are two sources of copper, primary, which corresponds to the copper mined, and secondary or scrap. Pure copper can be produced from any of them. During the 1960's on average 61% of the copper production came from primary sources.

Secondary copper is produced from old as well as new scrap. New scrap is waste produced during the manufacture of articles, including defective, finished or semi-finished goods that must be reworked. Old scrap consists of metal articles which once served a useful purpose but have been discarded. These articles may be worn out, obsolete or damaged.

Figure 2.1 is a simplified flow-chart of the copper industry, in which the world is considered as one unit.

Figure 2.1

Flow chart of the copper industry.



Primary copper is mined, concentrated, smelted and refined. The refined copper is mainly delivered to wire and brass mills, where copper is transformed into alloyed or unalloyed wires, rods, sheets or tubes.

These semi-manufactured products are incorporated in a variety of goods produced by the electrical industry, transport industry, construction and engineering industry, consumer goods and other activities. These articles enrich the stock of products that render service to society.

During the production process of these semi-manufactured articles as well as during their incorporation into final goods the new scrap is produced. This waste may be either reprocessed directly by the wire or brass mills or it may need to be smelted or refined before being reworked.

From the deposit of goods used by society, products containing copper are permanently discarded. The useful life of these articles is highly variable; for instance, in the case of a car it may be seven years and in underground electrical cables it may well be fifty years.

In most countries there is a well organised and complex network of scrap dealers engaged in the collection and recovery of scrap. The possible destinations of scrap are primary smelters, ingot makers, brass rolling mills, brass foundries and primary refiners.

Secondary smelters recover the copper by means of a melting furnace whose output is mainly used to produce alloy ingots required either by brass foundries or brass alloy mills.

Brass rolling mills manufacture wrought copper alloys, that is, they produce articles worked upon by one or more of the processes of rolling, forging, drawing or extruding. The process of fabrication is performed first by alloying the copper with other metals producing some standardized shapes. In general the range of chemical composition of the alloys is narrower than in casting, because they require a high degree of malleability to be worked hot or cold. The output comprises different shapes (wire, rods, sheets or tubes) used in the sectors already mentioned.

Brass foundries use an input scrap, alloys already prepared by ingot makers, and small amounts of virgen copper. In coppercasting a large quantity of irregular and rather complex shapes are produced. Although the chemical composition of the alloys is carefully controlled to obtain the required properties, the tolerances of impurities is greater than in wrought copper alloys.

Copper input of the wire mills is almost exclusively refined copper which may be processed from primary or secondary sources. About 55% of the copper input of the brass mills is refined copper. A rough estimate of the remainder might be 32% of new scrap and 13% of old scrap.

In the case of foundries and ingot makers an unimportant proportion of the total copper is refined, less than 5%; secondary old scrap is the basic copper input used in these activities. Old scrap is accumulated and recovered primarily in the industrialised nations which consume more than 94% of the refined copper produced in the world.

The most important sources of new scrap are brass and wire mills and to a lesser extent the producers of final goods. These activities have also been developed in the consumer countries.

It should be noted that along the whole process of production of copper there is recirculation of materials within the industry, but this type of scrap does not add copper to the total supply. It is likely that its rate of recovery may increase in time due to improvement in technology, but it is unlikely that the operation of the systems of recollection and recycling materials are affected by price fluctuations. Thus, new scrap may well be considered as stock rather than an additional source of copper.

Another characteristic of scrap is that most of its trade takes place within the borders of each nation. The exports are subjected to governmental control so the international trade is quite small. Thus it can be considered a national activity.

This study will concentrate its analysis on the international market of primary copper, that is, mainly on concentrates (output of the process of concentration) blister (output of primary smelters) and refined copper (output of the refineries).

Wire and brass mills can be regarded as the last stage of copper production, but in this study they are treated as the most important consumers of refined copper.

The industries that incorporate the different shapes manufactured by these fabricators will be called end users or final users.

## 2.3 Copper Reserves

### 2.3.1 Land Based Resources

Copper is a fairly abundant resource. About 0.01 per cent of the accessible surface of the earth is copper, that is, there are approximately  $3 \times 10^{15}$  tons of copper in the upper earth's crust. But only a very small part of that amount is recoverable in present economical and technical conditions.

The United States Geological Survey (1) estimated the total potential availability of primary copper and tabulated the information in four groups. First, copper reserves, that is, known deposits from which the mineral can be extracted profitably, considering the economic, technical and institutional conditions which prevailed when the estimate was done. Second, sub-economic resources, these are also known deposits but they cannot be processed economically in present conditions. Third, hypothetical resources, deposits whose existence has been inferred on the basis of the geological arguments. Finally, speculative resources are deposits which have not yet been found but whose existence is supported by geological arguments with less reliable evidence.

Table 2.1 summarizes the antecedents of this source of information.

Table 2.1

Potential availability of copper resources  
(million metric tons)

Reserves	283
Sub economic resources	314
Hypothetical resources	329
Speculative resources	263
TOTAL	1,189

Source: U.S. Geological Survey: Prof. Paper 820. 1973.

If the potential availability of copper is compared with the copper content of the upper surface of the earth, the former represents a very small fraction of the latter, 1 of  $3 \times 10^6$ .

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(1) D.P. Cox; R.G. Schmidt; J.D. Vine; H. Kirkemo; E.B. Tourtclot and M. Flescher. Copper. United States Mineral Resources: U.S. Geological Survey. Professional Paper 820, 1973.

The accuracy of the information on copper reserves not only depends upon the current geological knowledge but also on the assessment of the economic, technical, political and institutional conditions which define a deposit as exploitable. The deposits included as reserves may or may not be completely explored but quantitatively estimated and classified as economically exploitable.

When world copper reserves are estimated there is incomplete and/or poor information from some nations; some of them are important producers, as in the case of some socialist countries. For private companies this is confidential information and they are naturally reluctant to share it with others. The amount of reserves also depends on the prices of copper which are highly volatile.

The information of copper reserves must be considered an approximate order of magnitude of the mineral deposits economically workable at present when compared with current production or future demand for the mineral in question, it gives a general idea of its future availability.

A recent publication estimates the world copper reserves in 456 million tons (1). In 1960, they were estimates in 130 million tons (2). This represents a net increase of 138 per cent. In the same period, about 106 million tons of copper were mined, so the gross increase of the reserves was 331%.

Seven countries concentrate two-thirds of the world reserves, namely Canada, Chile, Peru, the U.S., the USSR, Zaire and Zambia. In 1960 their share was 84.6% and in 1976 had decreased to 75.7%.

Canada, the U.S. and to a lesser extent Peru increased their shares of the reserves (see table 2.2). In the case of the USSR the estimates implies a drastic reduction of its share but this may be due to lack of information.

The remaining three countries, all of them traditional producers and exporters of copper, show a reduction from 42.9 to 30.3%. The most significant reduction being experienced by the two central African countries.

The copper reserves of Asia, Oceania and Latino - American countries other than those already mentioned have experienced a significant increase in their share.

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(1) U.S. Bureau of Mines. Minerals Commodity Profiles. H.J. Schoeder: Copper. 1977.

(2) U.S. Department of Interior: A.D. McMahon: Copper, A Material Survey. Bureau of Mines IC 8225, 1965.



Important copper consuming countries have marginal exploitable copper resources, these are the case of the Western European countries and Japan where intensive exploration has already been done, therefore, it is unlikely that this situation will change in the future.

It is important to explain some of the causes of the changes in the structure of the copper reserves in the market economies. In the second half of the 1960's and the early 1970's Chile, Peru, Zaire and Zambia made important changes in their copper policies by increasing their control over this raw material through partial or total nationalisation and changes of their policies on mineral concessions. The private companies which exploited copper were not interested in making long run investments in exploration in areas considered by them as highly risky. On the other hand the governments of the countries which were increasing the control over their basic resources gave lower priority to exploration activities, being more concerned with the new conditions they were facing. In turn the governments of the industrialised countries, concerned with the changes which were taking place, provided support for their national mining firms for mineral exploration in potential alternative source of supply. This explains the increase of the share of the United States and Canada.

This situation can be reinforced by a report published recently (1) which states that 57% of the investment in exploration in 1961 was made in developing countries. By 1973-75 the proportion had dropped to 13.5%. It is not likely to have increased afterwards. For 1970, Bosson and Varon (2) give a similar percentage to that of 1973-75. Four industrialised countries have concentrated most of the investment (namely Australia, Canada, South Africa and the U.S.) which represent about a fifth of the land surface of the earth; it can be expected, therefore, that a re-distribution of the investment towards developing countries would permit a significant increase of the mineral reserves.

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- (1) P. Cheeseright Mine Development Hesitant, Financial Times, August 16, 1978, page 8.
  - (2) R. Bosson and V. Varon: The Mining Industry and the Developing Countries. Oxford University Press, 1977.

Table 2.2

World Copper Reserves  
(million metric tons)

	RESERVES					
	1960			1976		
	M.T.	%	Reserves Current Production Ratio	M.T.	%	Reserves Current Productin Ratio
<b>North America:</b>						
Canada	7.6	4.0	19	31	6.8	42
United States	29.5	15.3	30	84	18.4	58
Others	0.9	0.5		31	6.8	-
<b>TOTAL</b>	<b>38.0</b>	<b>19.8</b>		<b>146</b>	<b>32.0</b>	<b>-</b>
<b>South America:</b>						
Chile	41.7	21.7	78	84	18.4	84
Peru	11.4	5.9	63	32	7.0	146
Others	0.1			20	4.4	
<b>TOTAL</b>	<b>53.2</b>	<b>27.6</b>		<b>136</b>	<b>29.8</b>	
<b>Europe:</b>						
U.S.S.R.	31.7	16.5	69	60	13.2	35
Others	19.1	10.2		6	1.3	19
<b>TOTAL</b>	<b>51.4</b>	<b>26.7</b>		<b>66</b>	<b>14.5</b>	
<b>Africa:</b>						
Zaire	18.1	9.4	31	25	5.5	56
Zambia	22.7	11.8	39	29	6.4	41
Others	2.4	1.2		9	2.0	28
<b>TOTAL</b>	<b>43.2</b>	<b>22.4</b>		<b>63</b>	<b>13.9</b>	
Asia	5.7	2.9	23	27	5.9	55
Oceania	1.1	0.6	10	18	3.9	46
<b>TOTAL</b>	<b>129.6</b>	<b>100</b>	<b>31</b>	<b>456</b>	<b>100</b>	<b>57</b>

M.T. Million Tons

Sources: McMahon: Copper a Material Survey. Bureau of Mines 1965  
H.J. Schroeder, Copper. U.S. Bureau of Mines (Minerals  
Commodity Profiles) June 1977.

To evaluate the future availability of copper two indices are commonly used: the first compares the copper reserves with the current production or consumption of primary copper. To overcome in part the static dimension of this index, the current reserves are compared with the projected demand; the disadvantage of this measure is that it gives dynamism to the consumption while the reserves are assumed constant.

It is noted that continuous development in technology of exploration has permitted a relatively constant increase in the copper reserves and resources and that the techniques of exploration have been applied unevenly in different areas of the world. Moreover, the increase in the price of the metal and the developments in technology of exploration permit ore bodies of lower accessibility or lower quality to become economically mined.

The 1976 ratio of reserves to current production gives supplies for 57 years; for 1960, it was only 31 years.

Assuming that the demand for copper will grow either at 3 or 4 per cent per annum the world copper reserves would last until the year 2013 or 2018 respectively.

These estimations do not consider the on-shore identified and hypothetical copper resources which have been estimated at 1535 million tons by the Bureau of Mines (1); this would meet the copper requirements until the year 2035 assuming that demand grows at 4 per cent per year.

It can be concluded therefore that the stocks of reserves will not be a source of shortages of supply in the next 30 years. This conclusion rests on the hypothesis that energy will be available to undertake the operation of mining and processing.

### 2.3.2 Secondary Copper

Scrap is an additional source of copper. In the market economies there are between 100 and 140 million tons of copper in the articles which are rendering a service to society. Part of the copper contained in the articles which end their useful life is recovered and reprocessed.

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(1) H.J. Schroeder: Copper U.S. Bureau of Mines. June 1977.

In the market economies this source has supplied between 15 and 20 per cent of the consumption of refined copper. This percentage has considerable differences from one country to another. This may be due partly to the different structure and habit of consumption and partly to the different organisations of scrap collection. The countries which process an important proportion of their consumption seems to be those which have organised better the market of old scrap.

### 2.3.3 A Potential Source of Supply: Deep Seabed Copper Mining

Since the late 1950's a growing number of consortia, based on the U.S. but with Japanese and European associates, have been developing a technology to exploit the mineral resources of the seabed. Most of the information is kept secret, but significant progress has been reported (1). There are uncertainties about the possibilities of application of the technology in large scale operations and about the institutional conditions which will regulate the exploitation of these resources. The International Law of the Sea is being discussed in the United Nations, but no agreement has been reached so far.

The research and development has been concentrated in minerals contained in pebble-like accretions called manganese nodules found on the surface of the ocean floor. The nodules contain manganese, nickel, cobalt, copper and minor quantities of molybdenum, vanadium and zinc.

The U.S. Bureau of Mines has estimated the copper resources of the seabed as 760 million tons (2). It is noted that the area covered by the ocean is 70% of the earth's surface and this estimate represents 31% of the copper resources.

Although there are a few areas where nodules can not be found, the potential commercial mine sites have been located in the North Pacific Ocean, South West of Hawaii at 3,000 to 5,000 metres depth. The number of mine sites was estimated between 190 and 460 by Holser (3) and only 44 by Archer (4).

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- (1) Most of the companies had pilot plants either in schedule or in operation in 1977-79.
  - (2) Other sources estimation range between 170 and 7,900 million tons (Metal Bulletin, November 8, 1977, page 20).
  - (3) A. Holser: Manganese/Nodule Resources and Mine Site Availability. Ocean Mining Administration, August 1976.
  - (4) A. Archer: The Prospects for Exploitation of Manganese Nodules. Institute of Geological Science, London. Document ICS 1589 200 4/76.

The technology of exploitation of seabed manganese nodules consists of four phases: a) prospecting; b) gathering and lifting the nodules to the surface; c) transport of the nodules to the processing plants; d) treatment to recover the metals (1).

It is not within the scope of this study to describe the alternative technologies in development. It is sufficient to say that the methods include mechanical and hydraulic systems of extraction and hydrometallurgical and pyrometallurgical processing methods.

The processes of production are capital intensive. To support an exploitation of 3 million tons per year during 25 years the investment estimates range between 545 and 690 million dollars of 1977 (2).

The studies about the potential profitability of the exploitation of the deep sea nodules present divergent results, especially when comparing those elaborated by the UN and independent research fellows with those which have as their source the companies. For instance, C.R. Tinsley estimates an after tax return on capital of 13.5 and 15 per cent depending on the type of processing method adopted (3). One of the UN studies (4) estimates a pre-tax return which ranges between 43 and 109 per cent for a seven metal recovery operation and 54 to 94 per cent for a three metal recovery. The results of the latter study coincide with the analysis of Leipziger - Mudge (5). The results of the last two studies suggest that the profitability of these projects is relatively high, so the expansion of the exploitation of the seabed may be relatively rapid once the institutional conditions have been defined.

Based on the difficulties to reach an international agreement on the regulations of the seabed and the fact that technology is still being tested, it can be said that it is unlikely that the economic exploitation will start before 1985.

One of the characteristics of the seabed minerals exploitation is that the mineral content in the nodules are in proportions not related to their

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- (1) D.M. Leipziger and J.C. Mudge: Seabed Minerals Resources and the Economic Interest of Developing Countries. Ballenger Publishing Co. 1976, page 128.
  - (2) E. Chacko: The Economic of Deep Sea Nodules: An Appraisal of Recent Estimates. Natural Resource Forum V.2, No.2, January 1978, page 143.
  - (3) C.R. Tinsley: The Future Market for Nodules Metals. In A. Weiss World Mining and Metal Technology, Vol.1, American Institute of Mining Metallurgical and Petroleum Engineers, pages 249-266, 1976.
  - (4) UN A/Conf. 62/65: May 22, 1974.
  - (5) D.M. Leipziger, J.C. Mudge: Ob.cit.

demand. It is not possible to define here the inter-related problems that this situation impose.

To determine the magnitude of the operations of this activity on the copper industry three criteria were used:

I That seabed mining will supply 50 per cent of the demand for nickel in 1990. This hypothesis can be considered a rather optimistic view about the expansion of the exploitation of the floor of the sea.

II That a ceiling on the output of seabed mining will be imposed. It is assumed that the nickel seabed will absorb 60% of the calculated growth in neckel consumption, leaving the rest to the land based resources.

III That the companies involved will extract a relatively arbitrary amount of nodules by 1990, 20 million tons. The quantity was chosen on the basis that the companies have defined the economic scale on about 3 million tons per year, and that is likely that 6 companies undertake this operation.

It was assumed that the demand for nickel will grow at an average rate of 5% in 1975-90. It was also considered reasonable to expect that the nodules to be mined are those of the North Pacific whose average mineral content are 30% manganeze, 1.5% nickel, 1.3% copper and 0.4% cobalt.

Under each of the defined hypothesis, the 1990 copper extracted from the seabed would be the following:

Hypothesis:	I	II	III
Thousand Tons:	630	393	260

Assuming a 3.3 and 4.0 per cent average rate of growth of copper consumption in 1975-1990 the volume of production from this new source to the total copper supply would be relatively small, a highest of 5.5% and a lowest of 2%, whose impact on copper market should be relatively low.

Table 2.3

Possible alternative market share of copper seabed mining in total consumption in 1990  
(in percentage)

<u>Hypothesis</u>	Rate of growth of copper consumption	
	<u>3.4</u>	<u>4.0</u>
I	5.5	4.9
II	3.4	3.1
III	2.3	2.0

A report of the UN Secretariat referring the analysis to 1985, concluded that "the impact of production from nodules is expected to have a very minor impact on the copper market" (1). Similar conclusions were drawn by a study of UNCTAD, also referred to 1985 (2).

#### 2.4 The Mineral

There are more than 165 known copper minerals in the surface of the earth, but only 12 of them are commercially important. Out of these, 6 are the source of nearly 95% of the primary copper supply (3). According to their composition copper minerals are classified in three groups.

Native copper is the mineral found in a pure natural state; its importance is purely historical, for it represents a very small part of the total primary supply of the metal. Oxides are ores commonly formed by decomposition of sulfide ores as a result of having been exposed to the action of the air by erosion or other agents. Sulfides or copper combined with sulfur are the most abundant form in which the minerals is found: generally oxides are in the upper portion of the deposits and the sulfides in the lower.

Jacobsen (4) classified the copper deposits according to the rock association of the deposits. Based on his classification the 1974 world primary production had the structure described in table 2.4.

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- (1) UN Secretariat: UN, A/Conf. 62/65; 22 May, 1974, page 36.  
 (2) UNCTAD. An Integrated Programme for Commodities TD/B/C.1/185 June 6, 1975, page 7.  
 (3) H. Lammier: Copper. Encyclopedia of Chemical Technology. 2nd Ed. Volume 6.  
 (4) J.E.B. Jacobsen: Copper Deposits in Time and Space. Minerals Science and Engineering. Vol.7, No.4, October 1975, pages 337-371.

Table 2.4

Structure of the world copper mine production attending to geological characteristics of deposits

(in percentage)

<u>Type of Deposits</u>	<u>Percentage</u>
Porphyry	41.7
Sedimentary deposits	26.4
Volcanic deposits	22.6
Alkaline and basic magnetic	9.3
TOTAL	100.0

Source: World Copper Mines. Metal Bulletin. Special Issue.

The porphyry deposits account for the highest proportion not only of world copper supply but also of the identified and hypothetical resources, so they will continue to be a predominant source of supply. In deposits of this type the ores are disseminated rather uniformly through a large area. The ore is usually low in copper content, but there are wide variations from one area to another.

Sedimentary deposits account for about 30 per cent of the reserves of copper and a quarter of the primary supply. They are usually associated with cobalt. Most of them contain magnetite, hematite and sulfides combined with iron.

In some of the volcanic deposits the ores are disseminated as a breccia cement while in others the ores occur as massive sulfides. Jacobsen has demonstrated that there is a direct correlation between the age of vulcanogenic massive deposit and its copper-zinc ratio.

The grades of copper deposits are relatively low because the metal is spread over large areas, mixed with other minerals (especially sulfides and iron), rocks and other waste or useless materials. During the 1960's the average grade of the world copper mined was estimated at 1.25 per cent (1) and at 1.15 per cent in the first half of the 1970's. The grade of a deposit has an important influence on the size of the operation and the cost of processing the mineral, because it determines the movement of earth necessary to obtain a given amount of mineral.

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(1) Bureau of Mines. Copper - 1972.



Associated with copper there are usually minor amounts of other metals. In the United States, 14 metallic elements are recovered from mines operated for their copper content. A high proportion of the world cobalt production is recovered in processing the Zairean copper ores (1).

The association of copper with precious metals may have an important impact on the gross revenue of a company as in the case of Bougainville Copper Limited, where one fifth of its gross revenue was accounted for by the gold recovered from the Papua New Guinea deposit (2).

Many of the low grade copper deposits would not be exploited but for the by-products which enable the low grade copper ore to be mined economically. In other cases, copper is a by-product of mines exploited for other metals, but this source contributed a small part of the world supply.

The process of production used to recover the copper from a deposit is determined by the characteristics of the deposit, namely, its chemical composition (oxide, sulfides, or mixed mineral), its copper content, the additional elements that accompany the mineral, the depth at which the deposit is found, its rock association, hardness and other characteristics of the gangue. The combination of these highly variable properties determines the technology used to exploit a mine. For this reason some metallurgists say that each copper mine is particular and completely different from the others.

## 2.5 General Description of the Process of Production

The first operation in the process of production is the extraction of the ore from the deposit, and its transport to the mills where the material is crushed and ground. These processes are followed by two alternative methods of concentration, hydrometallurgy or pyrometallurgy; oxide mixed minerals or native copper are treated by the first and sulfides by the second. Hydrometallurgy or leaching is used to separate the minerals from the gangue by using solvents; depending on whether chemical or electrolytic recovery is used the output of this process must be either smelted, refined and melted, or melted and dispatched directly to the fabricators in the form of a cathode. Copper sulfides are treated by flotation instead of leaching, after which the minerals are smelted, and finally refined.

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- (1) Bureau of Mines. Copper - 1972.
  - (2) R.F. Mikesell: Foreign Investment in Copper Mining: Case Studies of Mines in Peru and Papua New Guinea. John Hopkins. 1975.

Most of the world primary copper supply originates from copper sulfides, but it has to be borne in mind that new developments of leaching have permitted the recovery of lower grade ores. Now copper is systematically recovered from materials which were considered wastes only a few years ago.

#### 2.5.1 Mining

Copper ore mining is basically an earth-moving operation whose magnitude is considerable, given the low grade of the copper deposits: it is necessary to extract one ton of material to obtain between 20 to 8 kilograms of metal. The extraction can be done by underground or open-pit operations. The choice between these methods depends upon the form, shape, and depth of the ore body, the copper content of the deposits, topography of the area, and the weather (1).

Any of these factors may be decisive in the choice of the method; for instance there could be a case in which the ore body is relatively close to the surface and the cost of removing the over burden is not excessive, yet an underground exploitation is decided on because adverse climatic conditions would affect the operations of an open-pit during some periods of the year.

The basic steps of an open-pit are drilling, blasting, loading and hauling. First, a line of explosive is used, then the material extracted by the explosion is leached by mechanical shovels, and finally hauled to the mill by rail or trucks. The trend has been towards larger loading and hauling units. The whole operation is capital intensive and most of its cost is accounted for by depreciation of equipment, maintenance of the machinery, and the capital cost of its provision. Another characteristic of an open-pit mine is that the time needed from the development of the mine until normal or optimal production is obtained is longer than in an underground operation. In an open-pit mine it is necessary to remove the over-burden and to strip the ore-body before the exploitation starts.

In underground mines the block caving system is generally used, in which the large deposit is undercut in blocks. The base and walls of each block are worked in such a way that through force of gravity the block gradually falls to the galleries of extraction from where the waste

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(1) McMahon: Ob.cit.

and ore are transported to the concentrating plant. Alternative methods of production are the so called room-and-pillar and the cut-and-fill.

Underground mines require more intensive labour than open pits, and more skilled workers, thus operation labour costs are higher. In an open pit labour represents about 40% of the total cost while in underground operations it represents about 60% (1).

On the basis of a study on costs of the U.S. copper industry by the USBM (2) it has been estimated that theoretically an underground cut-and-fill mine would require an ore grade of 10 to 12 per cent of copper to have costs per pound equivalent to those of an open-pit of 0.6 per cent copper content. Similarly, a room-and-pillar mine would need 5 to 6 per cent and a block cave mine 4 per cent copper. The grades of underground mines in operation are much lower.

In 1960, 53 per cent of the world primary copper supply came from underground operations and 43 per cent from open-pit mines; in 1970, the latter had increased its share to 58 per cent and in 1975 it was estimated to be 60 per cent. Lowell has predicted that, although during the next 30 years the bulk of the supply will come from open-pit mines, most of the new discoveries will be made in areas too deep to be mined from the surface (3).

The investment in research and development will probably increase considerably. In the U.S., about 80 per cent of the copper is extracted from open-pits, however the rate of conversion to underground copper mining will be faster than in other areas. This country has as disadvantages the high cost of labour and the lower grade of its deposits. Research is a mechanism of overcoming these competitive disadvantages.

#### 2.5.2 Concentration

The prime objective of the process of concentration is to reduce the waste of the ore. This stage of production is imposed by both the low copper content of the ore and the massive method of extraction.

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- (1) Simon Hobson: Mining Cost and Inflation. Metal Bulletin. Special Issue.
  - (2) Engineering and Mining Journal: Copper: The Birth of Modern Mass Mining of Low Grade Ore. Engineering and Mining Journal, June 1976 pages 70 - 75.
  - (3) David A. Lowell: Copper Resources in 1970. Jackling Award Lecture. Mining Engineering, April 1970.

As already mentioned, the method of concentration differs according to the chemical composition of the mineral, if it is an oxide, a mixed ore (1) or a native copper or a sulfide. In the case of the first three, leaching is used and in the latter flotation is employed. The treatment of the sulfides will be described first.

The concentration process presents variations according to the characteristics of the ore, such as the type of rock and the type of minerals associated with the copper.

But they involve crushing, grinding, classification (sizing), flotation and drying. The output are concentrates which have a copper content that may vary from 20 to 30 per cent.

The purpose of the first three operations (milling) is to prepare the material for the flotation. The mineral, finely disseminated through the rock, is separated from the bulk of the gangue, first by crushing and then by grinding the material until desirable sizes are achieved.

The process takes place in successive operations. First, in gyratory crushes; further reduction is accomplished by rod-mills whose output is transferred to primary and secondary ball mills which work in closed circuit with classifiers that operate in such a way that the material recirculates when necessary, while the finest material is delivered in order to continue to the flotation in the form of pulverized ores. To separate the copper from the gangue the process of flotation is used. It operates on the principle that different minerals have different wetting characteristics. The finely pulverized ores are introduced to successive flotation water cells to which a frothing agent and another chemical components, known as collectors, are added. Air is forced up from below producing a violent agitation. The sulfide minerals through the action of the collectors, adhere to the air bubbles and are carried up to the surface where they float in the froth: here they are extracted as concentrates. The waste material sinks to the bottom of the containers. The concentrate is drained, filtered and dispatched to the smelters.

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(1) The treatment of the mixed mineral depends on the proportion in which the two minerals are combined. If oxides predominate leaching is used, if sulfides, flotation; there are some types of mixed minerals for which a process known as TORCO was developed during the 1960's.

In this flotation process, the precious metals follow the sulfide minerals while other by-products such as molybdenum, lead and zinc, can be recovered by selective flotation.

The weight relation between input and output demands that the concentration plant must be located as close to the mine as possible so that the cost of transport can be reduced to the minimum.

A. Sutolov (1) gives information on the scale of production of the process from a historical perspective. The data are referred to the United States but can be extended to other areas.

In 1905, a typical mill plant had an operational capacity of 200 to 300 tons per day (tpd). The first four digit operational plant was built in 1906, at Utah, 2,000 tpd, which were increased almost immediately to 6,000 after its success was proved. In the middle 1930's the normal capacity had grown to 15,000 or 20,000 tpd, 30,000 to 40,000 in the 1950's and 1960's and to an average of more than 60,000 in the early 1970's.

Now, Sutolov states that there is a mill capacity of 176,000 tpd under consideration.

This development is obviously related to the decrease of mineral yield per ton of material mined from an average grade higher than 2.0 per cent, early in this century to one lower than 0.7 per cent at present (2).

The operations of mining and milling are capital intensive activities. The amount to be invested can fluctuate considerably with the characteristics of the deposits and the cost of the infrastructure necessary to exploit it. There also may be important variations depending on whether they are related to a new project or a mine which will expand its operation. Estimates of the value of the investment per ton are presented in the analysis of cost.

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(1) A. Sutolov. Porphyries Deposits. Miller Freeman, 1974.

(2) Similar results have been found analysing some stages of the evolution of the Chilean copper industry. The first concentration plant of El Teniente was completed in 1906 with a capacity of 250 tons of ore daily. In 1912 it had been enlarged to 3,000, the concentration plant of Potrerillos finished in 1927 had a capacity of 12,500 tpd while the one built in Chuquicamata in 1940 had 30,000 tpd.

Nowadays the concentration plants of El Teniente and Chuquicamata have a capacity of 58 and 65 thousands tons, respectively.

### 2.5.3 Hydrometallurgy or Leaching

Hydrometallurgy is applied to oxides and sulfides mine waste. In this process the ores are crushed, and then put into tanks where they are subjected to the action of a solvent. The metal is converted into a solution while the gangue remains unaltered. The second step is the extraction of copper from the solution. Two methods of recovery are usually employed, either chemical recovery or electrolysis. About 900,000 tons of copper were produced by hydrometallurgical techniques in the market economies in 1973.

The method of leaching varies according to the grade of the ore, composition of the mineral, and characteristics of the rock associated with the mineral, but the principles are basically the same.

Sulfuric acid is the most commonly used solvent for treating the copper oxides. This acid is a by-product of the process of smelting. In the United States, in the early 1970's, about half of the sulfuric acid recovered by the smelters was used to treat oxide minerals.

Of the two methods of recovery, the chemical process is generally used by the small and medium-sized mines. Electrolytic recovery not only needs an adequate supply of energy but also larger quantities to be treated.

The chemical method of recovery consists in the extraction of the metal from the sulfide copper solution by means of iron (sponge iron or scrap). The copper sulfate is introduced into tanks filled with iron scrap, which reacts with the sulfur, liberating the copper. The output called copper cement, has to be smelted and refined, and the sulfuric acid is not recoverable.

The electrolytic recovery method is similar to electric refining, except that insoluble anodes must be used in the precipitation of the copper from the acid. In this process the solution is passed through a series of tanks which contain insoluble anodes (such as antimonial lead) and sheets of copper operating as cathodes. Anodes and cathodes are arranged in an alternating way. A continuous electric current is introduced into the solution which reacts in such a way that the copper adheres to the cathode while sulfuric acid is regenerated. The copper recovered is known as concentrate which may not require further treatment except melting into standard shapes, while the sulfuric acid can be used again.

After the energy crisis there has not been either announced or implemented a single important project in hydrometallurgical processes but several in pyrometallurgical operations are being carried out (1). Hydrometallurgical methods were developed in the 1960's when the prices of copper were high and the cost of energy low, but this method requires at least twice as much more energy than smelting.

However, in 1976 the Engineering Mining Journal reported that all the U.S. companies were undertaking research on hydrometallurgy but orientated towards energy savings methods. New techniques, currently at different stages of development, are emerging. In 1976, Cyprus Mines one of the sponsors of the Cymet process, reported a drastic reduction of the energy consumption for electrolytic requirements. Promising reports about other methods, such as the Arbiter Clear and the roast-leach-electrowining processes, have also been made.

#### 2.5.4 Smelting

Smelting consists of three operations: roasting, reverberatory furnace and converting. The output of these processes are calcine, matte and blister copper, the latter is from 98.0 to 99.5 per cent pure, but it requires further processing in order to be used by the manufacturers.

In roasting, the concentrate is heated in the presence of air. The purposes of the operation are multiple: to remove part of the sulfur in order to obtain a favourable balance of the components of the matte (input of the convertors); to dry the concentrates; to eliminate some volatile elements such as arsenic and antimony, and finally to oxidize part of the iron.

The output of the process is called calcine, which consists of a mixture of sulfur, copper, iron, gangue and other non volatile materials. It has been a persistent trend to eliminate the conventional roasting process because of improvement of the control of the concentrates in the flotation as well as in the reverberatory furnace. Some mining companies are using a process called fluosolid roasting which permits a better treatment of the surface of the particles which results in almost instantaneous reaction.

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(1) Commodity Metals: M.G. Manzone. Copper Journal of Metals, March 1975, page 15.

Either as calcines or concentrates the material reaches the reverberating furnace where they are heated in the presence of fluxes, and reduced to a molten state.

The smelted material forms into two layers, one above the other. At the bottom lies a mixture of cuprous and ferrous sulfides (the matte) of higher specific gravity than slag. The slag of lower density is above. Both materials are recovered from the furnace by separate outlets. Precious metals and other elements are contained in the matte (1).

The matte is transferred, while still molten to the converters in order to remove the sulfur and iron. The process is based on the fact that copper has a lower affinity for oxygen than iron and sulfur and that the oxidation of sulfur and iron liberates large quantities of heat. After the converter has been charged with matte, air and another component, silice, are introduced; the resulting oxidation generates heat. First, the iron oxides, combined with the silice form slag which is removed from the converter.

After the removal of the slag, the process of oxidation continues and the sulfur is eliminated from the converter as a gas in the form of dioxide of sulfur while metallic copper is formed, but small amounts of impurities remain. The resulting product is blister copper with a grade of copper up to 99.5 per cent. It should be noted that some slag contains so much copper that it must be treated again in the reverberatory furnace. The dioxide of sulfur is partially recovered to manufacture sulfuric acid.

The output of the converter may be transferred to a casting furnace, where it can be either cast in cakes to be sold to other refineries or cast into anodes to be electrolytic refined, but blister copper can also be directly transformed as molten metal to rotatory or reverberatory furnaces for fire refining.

One of the objectives of the process of smelting is to separate the copper from the sulfur. In the converter stage, about 75% of the sulfur is driven off the feed in a stream of  $\text{SO}_2$  gas of variable concentration, but roughly averaging 4%. This stream is not quite enough to sustain its recovery through acid making or other sulfur fixation process. For these reasons until a few years ago it was general practice to liberate most of the gas in the atmosphere, recovering a small proportion of  $\text{SO}_2$ .

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(1) Materials and Technology Encyclopedia. Vol.III, Metals and Ores. T.J.W. VanThoor Edition, 1970.



The other 25% of SO<sub>2</sub> is emitted during the process of matte smelting in a stream of roughly 1% SO<sub>2</sub> which is far too weak for acid making.

The industrialised countries have been concerned with the emission of sulfur in the process of smelting and the governments have lowered the standards of maximum amounts of sulfur allowed to be liberated into the atmosphere.

Due to the difficulties of meeting the contamination standards with the traditional reverberatory furnace some technologists have stated that this process has a high probability of becoming environmentally obsolete (1).

The standards of decontamination of the atmosphere vary from one country to another. The problem has been more important in the U.S. for several reasons: firstly, when the new regulations were introduced the smelters were older than in other areas: secondly, according to a report of the OECD the ambient standards imposed in this country appear to be most severe (2). Thirdly, the problem affects almost the total smelting capacity of production, determining that the facilities had to be either replaced or drastically modified. Fourthly, the time for implementation of the pollution control programme, from the companies point of view, was extremely short considering the magnitude of the task and the financial commitment imposed by the new environmental standards.

In the U.S., the regulations establish that no more than 10% of the sulfur entering into the smelter can be emitted to the atmosphere and that the average SO<sub>2</sub> content anywhere at ground level on one day must not exceed 0.03 pound per cubic meter.

In 1965, the SO<sub>2</sub> emitted was estimated as 90% (3); 80% in 1970 and had been reduced to 60% (4) in 1975; this amount was still well above the standards.

The recovery of the SO<sub>2</sub> has determined three general problems:

- i) How to capture the SO<sub>2</sub> at the established levels.

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- (1) P. Tarassoff: Pyrometallurgy: Journal of Metals, March 1976, page 12.
  - (2) OECD: Economics Implications of Pollution Control: A General Assessment Feb. 1974, page 19.
  - (3) U.S. Bureau of Mines. Department of Interior. Control of Sulfur Oxide Emission in Copper Smelting.
  - (4) U.S. Bureau of Mines. N.J. Schroeder, Copper 1977.

- ii) What to do with the by-product: this is particularly important because this regulation not only affects the copper industry but also other activities which also emit  $\text{SO}_2$ .
- iii) How to store the product.

The enormous expenses of meeting clear air standards has generated a wide type of responses from the producers. The improvement of the efficiency of the conventional smelters, based on the reverberatory furnace, attracted some producers; other producers have used the Onohama smelter (Japan), which permits a 99.7% fixation of the sulfur input. The Otokumpu flash smelting process, which was first commercialised in 1949, has gained wide acceptance in the new scenery. The Noranda process, by which smelting is carried out continuously, instead of the traditional three steps, permits recovery of more than 95% of the  $\text{SO}_2$ . Alternatively some producers have chosen the use of an electrical furnace.

The new environmental standards have been a considerable pressure to invest in research: the Q-S Oxygen Process for continuous smelting and converting, still in development, is one of the promising developments. There are also a relatively large number of processes which do not reach commercial stage. Alternatively, hydrometallurgical methods of treatment of copper intending to reduce energy consumption are in development.

As far as it was possible to determine, the second problem has not a foreseeable solution. Supply of sulfuric acid will be in surplus. This situation will be an important pressure on the one side to intensify the use of sulfuric acid in traditional uses such as the recovery of copper from materials considered as waste through traditional methods of leaching; on the other side to search for new uses among which the development of hydrometallurgy seems to be one of the most relevant to the copper industry. On this ground, it is important to note that since the late 1960's, the U.S. Bureau of Mines have been mentioning a possible development, namely the leaching in-situ of low grade copper deposits by using underground nuclear detonations.

As a result of the oversupply of sulfuric acid, the storage problem seems considerably important, especially when it coincides that this acid is relatively unstable. As a more permanent solution, elaboration of elemental sulfur has been envisaged, which is a more permanent product and cheaper to store. Outokumpu Oy has been recovering elemental sulfur in

an operation in Botswana, a Canadian company has also developed a method.

The impact on cost of the SO<sub>2</sub> standards varies widely between one source of information and another. For the U.S., it has been generally estimated between 2 and 3 cents. If this value is accepted, it represents an increase of about 30 per cent in the cost of this process of production. However, it is unlikely that the smelters will absorb this additional cost through reduction of profits or increase in productivity, most likely it will be transferred to the consumers through higher prices; the custom smelters also have the possibility to transfer it to the primary producers.

#### 2.5.5 Refining

Refining is defined as the process of removal of other elements from the extracted metal for the purpose of improving the purity or adjusting the composition. Danmalt has pointed out that originally "fining" meant the first treatment applied to an ore to improve its purity, subsequent operations becoming "re-finishing" (1).

The blister can be either fire or electrolytically refined. The choice between the two methods depends upon the purity required, on the composition of the blister, and particularly on the precious metal content. The recovery of some impurities is poor in fire refining, and precious metals cannot be recovered.

Fire refining is done in either revolving or reverberatory furnaces. Air or oxygen is introduced through the molten material reducing the remaining impurities to slag while other impurities are eliminated by volatilization. When the oxidation has taken place, green wood is added to the molten metal to diminish the oxygen of the copper until 0.03 to 0.05 per cent is obtained.

The output, called tough-pitch copper is cast in an anode furnace into commercial shapes, such as billets, cakes or wire bars.

The electrolytic refining is performed in tanks containing a solution of copper sulfate and sulfuric acid. The input is blister copper anode, semi-fire refined. The anodes are suspended and are interleaved with sheets of pure copper as cathodes. The solution slowly dissolves the anodes while an electric current is applied.

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(1) A.R. Bailey: A Text-Book of Metallurgy. MacMillan. New York. 1956.

The pure copper is deposited in the cathodes which are roughly 30 times heavier at the end of the process.

The anodes are not normally dissolved altogether and are sent back to be reprocessed. The other constituents of the anode either dissolve in the solution (called electrolyte) or fall to the bottom of the tank, forming a slime whose most important constituents are the precious metals and other elements such as platinum, selenium, tellerium and copper. After recovering the latter, the other metals are treated in another plant.

The cathodes can either be sold as such or melted into established commercial shapes such as wire bars, billets, cakes, ingots, ingot bars or slabs.

Since continuous casting was developed in the steel industry, efforts were made to adapt it to the copper industry. It took a long period to overcome the technical difficulties but only in the late 1960's there were some mills which had started to use it.

Before the adoption of this process, the refineries remelted the cathodes into wire bars which were dispatched to the semi-manufacturers where they had to be heated and allowed to cool and then reheated again for working. Most of these steps can be avoided by using continuous casting transforming directly the cathodes into rods.

Until the energy crisis there was still discussion among the analysts of the copper industry whether the refineries or the mills should operate the new process. But the abrupt price increase of energy augmented the saving from the use of the new process, and so the rate of diffusion of the innovation being adopted by those nations with higher investment capacity, the industrialised economies. In 1976 most of the reports agreed that there was over capacity of production of continuous casting in the European countries.

Theoretically this situation can be explained as follows: a new process is profitable when the net present value (NPV) of the operating savings obtained by the use of the new process is greater than the net investment required to obtain those savings. If the NPV is positive, other factors constant, the process is adopted. The greater the NPV, the faster the new process will tend to be adopted.

$$NPV = \sum_{t=0}^{t=C} \frac{(VC_m t - VC_o t) Qt + FC_m t - FC_o t}{(1+i)^C} - I_n \quad (1)$$

(1) Based on R.W. Shaw and C.J. Sutton: Industry and Competition: Industrial Case Studies. MacMillian, 1976.

Table 2.5

Capacity of production of continuous casting in some European countries

(in thousand tons)

Country	1976 Rod Consumption	Continuous cast rod capacity in early 1978	Excess of consumption over capacity
U.K.	230	245	-15
Belgium	40	250	-210
West Germany	400	246	154
Italy	230	285	-55
France	320	54	266
Greece	15	90	-75
Sweden	50	90	40

Source: Copper Studies, December 16, 1977.

Where NPV: Net present value; VC: variable cost; Q: quantity produced; FC: fix cost excluded depreciation; I: investment required for the new process; i: rate of interest; subscripts n: new equipment and o: old equipment; c: time period.

There is no definite rule which may define the location of a refinery except the availability of energy. One analysis referring to location of smelters (1) concluded that a refinery installed alongside a smelter gives some advantage not only because it permits the integration of services but also because it improves the reprocessing. From the analysis of 22 smelter projects 12 were going to incorporate refineries and 3 of the refineries located in a different place than the smelter were going to service the smelter.

The investment per annual ton at refinery capacity has been estimated at \$600 (2) so that a medium size refinery would cost around 48 million dollars.

2.6 Uses of Refined Copper

Refined copper is mainly consumed by wire and brass mills. Wire mills produce bare wire, insulated, electrical and communication wire.

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- (1) G.M. Voir. The Investor. Choice in Smelter Location. Metal Bulletin.  
Special Issue.  
(2) UNCTAD. Contribution from the United States of America. TD/B/IPC/copper/AC/L6, January 1977.

The percentage of the total refined copper used by wire mills varies from one country to another, but it can be roughly estimated at 60%. Brass mills account for 37%, producing wire tubes, rods or sheets. Secondary smelters, foundries, chemical plants and other industries account for the balance. Brass mills also use about 30% of the purchased copper scrap, while primary and secondary smelters and refiners consume more than 60%, the remaining industries (foundries, chemical plants and others) consume the balance (1).

Refined copper is transformed into different shapes by wire and brass mills and then delivered to end users which incorporate "the semis" in capital or consumer goods.

It should be noted that in more than 60% of the total production copper is worked as a pure metal. The most important copper alloy is brass which represents nearly 35 per cent of the total while other alloys such as bronze, nickel - silver and cupro-nickel form the balance. The table 2.6 presents the productive structure in copper and copper alloy semi-manufactured, by type of product, in the United Kingdom.

Table 2.6

United Kingdom Structure of Production of Copper and Copper Alloy

Semi-manufactured by types of products

(in percentage)

	Wire	Rods, bars and sections	Sheet, streer and plates	Tubes	Total
Silver	95.7	9.5	38.1	66.2	61.1
Brass	3.0	86.9	50.8	15.8	34.6
Nickel, silver and cupro-nickel	0.4	-	7.6	-	1.8
Bronze	0.7	1.8	3.4	4.2	2.0
Other Alloys	0.2	1.8	0.1	-	0.5
TOTAL	100	100	100	100	100

Source: The British Non Ferrous Metal Federation: Annual Report, 1976

Although the description of the process of production can be considered as completed, it is still necessary to incorporate the semi-manufactured products in consumer and capital goods. Table 2.7 displays the distribution by economic activity of the final uses of copper in the most important non-socialist copper consuming countries.

(1) The low percentage of copper accounted for by foundries result from the fact that they use as raw material the output of secondary smelters or ingot makers.

Table 2.7

End Uses of Copper and copper alloys in some important copper  
consuming countries 1974  
(in percentage)

<u>Countries</u>	<u>Electrical Industry</u>	<u>Construction</u>	<u>Transport</u>	<u>General Engineering</u>	<u>Other Uses</u>	<u>Total</u>
France	47.0	15.9	10.2	16.0	10.9	100
W. Germany	54.3	15.5	10.7	14.0	5.5	100
Italy	42.5	16.7	10.9	18.9	11.0	100
Japan	52.2	8.9	17.6	15.0	6.3	100
U.K.	41.8	17.7	10.6	23.7	6.2	100
U.S.	46.2	15.9	10.1	18.8	9.0	100

### 2.6.1 Electrical Industry

This is the most important final use of copper, about 49% in the market economies in 1974. All the material and equipment employed to generate and transport electricity, whether the copper serves as a conductor of electricity or as a performer of other functions such as telecommunications, have been classified in this sector. The manufacture of electric motors, transformers, power and motor generator sets, switchgear, telecommunication and electronic equipment are among the most important uses of copper.

In this sector the consumption of copper has been affected by the trend towards miniaturization of the electric circuits. It is difficult to define the net effect of this trend because the reduction in the amount of copper per component seems to have been compensated for by an enlargement of the number of units produced (1).

Most of the copper is used in the form of wires which is the field where the threat of substitution of copper for aluminium has been persistent and important during the last decade.

In the U.K., aluminium cables and wires were about 2.0% of the total wire and cable used in 1962; eleven years later its share had increased to about 12%. If such a substitution had not taken place, the U.K. copper consumption would have been 10% higher than it really was in 1974. Most of the substitution took place when the ratio between the prices of copper to aluminium considerably increased in the second half of the 1960's (see table 2.8). After 1969, the rate of substitution diminished, in spite of the soaring copper prices in 1973-74.

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(1) T.B. Marsden - A.V. Hall: Market for Rolled Copper - Base Products. Metals Technology, March 1975, pages 98-103.

Table 2.8

Approximate percentages of aluminium and copper wires and cables  
consumed in the U.K.

<u>Years</u>	<u>Copper Percentage</u>	<u>Aluminium Percentage</u>	<u>Total</u>	<u>Ratio: copper- -aluminium prices</u>
1963	96.5	3.5	100	1.16
1964	95.0	5.0	100	1.73
1965	94.0	6.0	100	2.14
1966	91.5	8.5	100	2.53
1967	90.5	9.5	100	1.90
1968	89.0	11.0	100	2.42
1969	88.0	12.0	100	2.80
1970	88.0	12.0	100	2.53
1971	89.0	11.0	100	2.10
1972	89.5	10.5	100	3.29
1973	89.0	11.0	100	2.77
1974	88.0	12.0	100	1.31

Source: Roskill Information Service Ltd.: Copper, Survey of World Production, Consumption and Prices. Roskill Information Services Ltd. 1975, page 249.

Copper is a better conductor of electricity than aluminium per unit of volume while aluminium has about twice the conductivity of copper per unit of weight. However to obtain the same electrical performance a cable or wire of aluminium must have greater sectional area than a cable or wire of copper. For this reason copper will continue to be dominant in applications where the economies of space are important. Moreover, since most of the wires and cables are insulated, the lower price of aluminium may be compensated by greater expenses in insulation; this factor has become particularly important after the increase of the oil prices. Other difficulties associated with the adoption of aluminium cables and wires are its lower flexing fatigue strength and poor contact resistance performance.

Another threat that may affect the consumption of copper in the future is the use of optical fibres in the communication industry as a replacement for copper cables. The President of Cerro Copper Corporation has stated that United States Companies are expending more than U.S. \$400 million a year to develop this new product (1). However, if this development is successful this new threat would begin to materialise in the second half of the next decade (2).

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(1) Copper Producers Face Future of Uncertainty. Latin American Commodities Report, December 24, 1976.

(2) UNCTAD Contribution From Australia.



### 2.6.2 Construction

This sector uses about 15% of the total copper consumed in the market economies (this percentage does not include the electrical installations which were already considered in the electrical sector). In this sector copper is consumed as tubes and also rod alloys, the latter material is used for the manufacture of plumbing fittings.

In 1972, in France, the distribution among the final uses of copper within this sector was as follows:

Sanitary fitting	38.7%
Water tubes	54.3%
Decorative ware	3.2%
Locks	2.7%
Other water and sanitary	1.1%
TOTAL	100.0%

In tubes for water systems, complete penetration of the market was achieved in France, Holland and the United Kingdom, but in countries such as Austria, Italy and Denmark less than 20% of the new construction use copper tubes (1). The Italian situation is rather peculiar because the use of copper tubes for cold water was prohibited until a few years ago.

Plastic has been used instead of copper in plumbing; but after the oil increase the situation became favourable to copper.

Stainless steel is another substitute of copper in the water tube market; as far as was possible to determine, it has captured only a marginal percentage of the market; less than 5% in the U.K. (2).

### 2.6.3 General Engineering

General engineering includes the production of non-electrical products such as machine tools, precision instruments, heat exchangers, sea desalination plants, equipment for the chemical industries; paper, sugar refining industries, etc. These activities absorbed about 17% of the copper in the market economies.

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(1) M.J. Smith ; T.B. Marsden: Brass Mill Products in Western Europe. Metals and Materials, May 1973, pages 305-316.

(2) Skinner: Ob.cit., page 253.

In France, in 1972, the distribution of the copper consumption was as follows:

Industrial valves	49.0%
Heat exchangers	20.3%
Machine Tools	17.0%
Anodes	3.3%
Foil	1.3%
Others	9.1%
TOTAL	100.0%

In the general engineering sector, technical improvements leading to greater efficiencies are in continuous development, as well as investigations orientated to the analysis of possible substitutes of one material for another.

Valves, pumps and fittings are the most important final use of copper. In these products copper is preferred because of its strength, corrosion resistance and easy machineability. Stainless steel has made a limited inroad in these markets.

The heat exchangers and condensers tubes in power stations use cupro-nickel alloy. However, it has been announced that coastal power station in the U.S. started to use titanium in 1972; but it was not possible to determine the magnitude of the penetration; in the U.K., titanium has been used for several years, but it does not cover more than 12% of the total. In nuclear power stations, where safety is an important consideration copper has maintained a dominant position.

Desalination plants has become an important market in the 1970's. In the 1960's, a few plants of small capacity were built, but early in this decade, demand for larger plants began to increase. After the oil price increase, the Middle East countries announced an investment of 1.5 billion pounds to build a total capacity of 500 millions gallons per day. Titanium has been used in some of these plants but it is expected that cupro-nickel will maintain the major portion of this market.

Possible new markets for copper usually mentioned by the analysts are air heat exchangers and fishing farms.

In general engineering copper will tend to become more important because its easy machineability, and raw material prices have tended to grow less than labour cost in the industrialised countries.

#### 2.6.4 Domestic appliances and other uses

This sector includes domestic appliances and utensils such as cutlery, ammunition and coinage. These activities represent 8% of the total copper consumption.

In domestic appliances and cutlery, stainless steel made important inroads into the once traditional market of cupro-nickel alloys. Nowadays this field is usually mentioned as one area in which substitution may have reached the limits of the possible.

There is no public information about the uses of copper for military purposes in most of the countries for national security reasons. The United States Department of Commerce publishes a statistical series in which the total deliveries from mills and foundries are classified in non-military and military uses: the latter represented a highly fluctuating percentage of the total shipment, varying from a low 2.3 to the highest of 10 per cent in the period 1967-74; obviously the highest percentages were during the peak period of the Vietnam War (1). Another publication estimated that the U.S. army used 10 per cent of the total U.S. consumption but it is not specified the year this information referred to (2). Although it is not possible to define the extent, it is also known that stainless steel has made an inroad in the ammunition market.

Minted coinage represents a very small percentage of the total consumption in the Western European countries; this item is more important in the United States, about 1% of the total consumption. In this country alloyed copper replaced 90% silver coins minted prior to 1965. In 1974, the copper prices reached a record level and the copper content of each coin was more valuable than the coin itself, so the coins began to disappear from circulation and were being smelted, although this action carries severe legal punishment (3). The government tried to pass a bill in the Senate to allow pennies to be minted from aluminium but this requirement created great resistance among vending machine operators because coins of aluminium would be too light to activate the machines; the situation was overcome when the price of copper fell and the authorities obtained permission to reduce the amount of copper in the coins (4).

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- (1) U.S. Department of Commerce: 1974:, Annual Statistical Supplement.
  - (2) U.S. Senate. Permanent Sub-Committee on Investigations of the Committee on Government Operations: Materials Shortages, Copper, February 1975.
  - (3) It has been estimated that when the copper price is higher than 1.20 cents per pound, the copper content in one penny exceeds its normal value.
  - (4) The description is based on issues of the New York Times of 1974.

### 2.6.5 Transport Industry

Transport industry includes the equipment of transport by road, water, air and rail. It accounts for 10% of the total.

Road transport is by far the most important user, 62% of the total of this sector. Copper consumption in this industry has remained almost constant during the last ten years due to the more rational use of this raw material. For instance, in 1962 in a U.K. medium size car of 1.500 c.c. 5Kg. of copper were used in the radiator while in 1972 the similar model required only 4Kg. The energy crisis may shift the demand to more compact models, probably reducing the amount of copper of this sector. The introduction of an aluminium radiator has been tried since the late 1960's, unsuccessfully so far. However, a recent report states that a French manufacturer has developed a model which is in use in France and Germany. As a counter-move a British manufacturer, subsidized by the copper industry, has developed a radiator which uses 25% less metal (1).

Water transport absorbs 25% of the copper input of the transport industry. Although the demand for copper does not increase in proportion to ship tonnage an increase of demand is expected in tube and plates due to the larger steam turbine engines.

The requirements of copper by rail transport are relatively small with respect to the total copper input of the transport industry, namely 3%. Most of the copper is used in motors and generators, overhead contact wire and signalling systems. A new system of disc brakes, more efficient at low temperatures, has successfully been developed; it uses a copper chrome alloy.

Finally transport by air is a fairly small copper consumer in the sector under consideration, 1 per cent. But aeroplane construction is a sector in which purchases rest more on reliability than on price, besides, economy of space is important, so copper will continue to be used in this field.

### 2.7 Some General Characteristics of the Demand for Copper

Copper is a raw material, thus its demand is derived, that is, its demand as well as the quantity demanded depend upon the demand for the final products. The higher the rate of growth of the final products in

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(1) D. Wright: Consumption of Copper in the Transport Industry. Financial Times, August 16, 1978, page 9.

which copper is a part, the faster the growth of the demand for copper tends to be. This does not necessarily mean proportional increases because changes in design or technological improvement of the final product may affect the requirements of copper per unit of the final good.

Final users of copper are industries which are making permanent efforts to reduce the use of input as much as possible. A result of such behaviour is the actual trend towards miniaturization of components in the electric and electronic industry; another similar example is the use of smaller bore tubes in central heating; thinner copper and copper alloy sheets and strips are produced due to a more rational utilization of the raw material in radiators in the car industry; tubes of smaller size and thinner walls are used in the construction industry for water plumbing. These trends towards miniaturization and thinning down do not necessarily mean reduction in the amount produced in terms of tons but that the demand for copper tends to grow at a lower rate than those sectors.

Attending to the composition of the final uses, copper is incorporated in durable consumer goods, 20 to 25 per cent, and capital goods, 75 to 80 per cent. Both of them the most sensitive to the capitalist cycle: during recessions the demand for capital and durable consumer goods tend to fall more than for non-durable goods or services while in the booms they expand faster than non-durables. The demand for copper increases (falls) in a higher proportion than the final goods, in which it is an input due to the effect of the stocks.

These are two of the factors which explain the fluctuation of the demand for copper and its volatile price. It is also noted that among the final users of copper there are activities such as construction, electrification and transport which are considered parameters of action when either deflationary or inflationary government economic policies are applied. These sectors are used as policy targets because they can easily be affected by the instruments available to the governments i.e. direct sanctioning of capital investments in the public sector and regulation of the rate of interest and credit conditions which may affect the level of economic activity in the private sector.

It must be considered that the amounts of copper employed in most of its final uses represents a small proportion of the value of those goods, for instance the 30 to 40 pounds of copper utilized in each U.S. vehicle or the 22 pounds contained in a typical U.K. car 1.500c.c. represent a small percentage of the value of the cars, the same can be said about

the one pound of copper used in a television set; another example is a new house, which requires about 35-45Kgs. of copper whose value represents a very small percentage of the price of that house. The situation described suggests that variations in the prices of copper do not affect the price of the final goods.

On the other hand, if the prices of copper increase while the prices of its substitutes (aluminium, stainless steel, plastic or others) remain constant, the effect of such variation in the quantity demanded may be negligible in the short term: this is because the use of the substitutes implies changes in the process of production, redesigning of final goods, probable investment in capital etc. But the longer the period of time considered, the greater are the possibilities of substitution.

So it can be concluded that copper is a price-inelastic product in the short term, but the longer the period considered, the higher the price elasticity will be. Econometric studies, using from the simplest to the most sophisticated methods, have estimated the price elasticity of demand between 0.2 to 0.45 for periods shorter than one year (1) while in the long term the range of variation is between 0.7 to 2.5

## 2.8 Demand Forecast

In the mid 1970's, world copper consumption of primary copper was about 6.5 million tons. Long term projections of demand forecast requirements of primary copper within a range of 14 to 23 million tons in the year 2000. Table 2.9 summarizes the result of five demand projections elaborated in the 1970's.

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(1) For instance: Charles River Associated: Analysis of the Copper Industry. Realised by the U.S. Department of Commerce through Clearinghouse (Boston 1970).

P.H. Cootner; F.M. Fisher: An econometric Model of the World Copper Industry. Department of Economics. Massachusetts Institute of Technology. Working Paper No.70, April 1971.

R. Baeza; P. Cussen; C. Vignolo: El Mercado Mundial del Cobre. Analisis y Modelamiento, Centro de Planeamiento, Universidad de Chile. Junio, 1975.

Table 2.9

Forecast of World Demand for primary copper to the year 2000  
(Million tons)

Studies	Date of Publication	Base Year Forecast	Demand		Average Rate of Growth
			1985	2000	
Malenbaum (a)	1972	1967 - 69	19.0		4.1
U.S. Bureau of Mines (b)	1971	1969	11.2	22.6	4.5
Wharton School of Finance and Commerce (c)	1973	1966 - 69		17.0	3.7
The Swedish Committee on Minerals Policy (Preliminary forecast) (c)	1976	1972	10.0	14.0	2.8
U.S. Bureau of Mines (d)	1977	1975	10.0	17.7	3.7

## Sources:

- a) W. Malenbaum Materials Requirements in the U.S. and Abroad in the Year 2000. Paper prepared for the National Commission on Materials Policy, Philadelphia, Pa, 1972, mimeo.
- b) U.S. Bureau of Mines: Commodity Statement, Copper 1971.
- c) CIPEC: Two More Views on Copper's Future. CIPEC Quarterly Review January - March 1977, pages 37-42.
- d) U.S. Bureau of Mines. Minerals Commodity Profile H.J. Schroeder Copper - 1977, June 1977

It is noted that the studies published early in the 1970's forecast the higher values of demand for primary copper. This can be explained by the changes of two assumptions.

- 1) The latest studies assume a lower rate of growth in the GNP in the most important copper consuming areas, the industrialised market economies. This is possibly influenced by the fact that the earlier projections were done after 30 years of almost uninterrupted growth in the market economies, while the latest reflect the more pessimistic views of the recession and monetary disequilibrium of the mid-1970's and the impact of the energy price increases of 1973-74.

A demand forecast by UN not included in table 2.9 assumes a comparatively high rate of growth of copper for 1977-1990, 4.3% per annum (1), which is almost, equal to the historical rate of growth of consumption.

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(1) Metal Bulletin: UN Plots Copper's Future. Metal Bulletin November 8th, 1977. J F Shew: Investment in the Copper Industry: Needs and Policies. Natural Resources Forum, Vol. 2, No. 2, Jan. 1978.

2) The earlier estimates assume that the rate of recovery of old scrap was to remain constant while the more recent studies suppose that secondary copper will increase its share to the total supply, for example in the 1977 U.S. Bureau of Mines study, old scrap would increase its participation from 22 to 31 per cent in the U.S.

All the studies consider that technological improvements will permit a better final use of copper and that substitution of copper for other materials will be relatively important in electrical and non-electrical applications; but the studies do not give a basis to be compared quantitatively in this respect. However, they generally agree on the general trends:

In the electrical sector, the use of aluminium in cables of lower voltages, microminiaturization of electric circuit; use of other systems of transmissions in communications; drops in the rate of growth of some electrical consumers goods in developed countries due to almost saturation of the market. Among the factors which may boost copper consumption are usually mentioned automation and the more extensive use of electronic equipment, especially computer control; increasing demand for recreation in industrialised countries and more intense use of under ground electrical transmission systems.

In construction substitution will not be important with the possible exception of cold water tubing. In transport, some of the studies forecast more substitution of copper in the automotive industry; as a possible favourable factors affecting copper consumption are mentioned, the use of electrical cars and improvements in public transport which in some cases require electrical system of control.

As possible important future markets for copper, some of the studies referred to the use of solar energy and desalination plants but they do not specify possible ranges volume of demand.

The projection by final uses, when included, are not comparable due to the different definitions of the sectors or because they are not referred to the same areas.

When the studies make reference to the future demand by a group of countries or areas, the result is a substantial increase of consumption in developing countries and a drop in industrialised market economies: the logic behind this result, apart of the smaller base of the less developed countries, is discussed later. Concerning the consumption of copper in the centrally planned economies, the studies forecast that they will have



an even more important share in world consumption, but unfortunately the hypothesis is not discussed explicitly.

Despite the drop of the future rate of growth of copper consumption suggested by most of the studies world production would have to expand initially, by a least 300,000 tons per year. This amount is higher than the 1975 output of important copper producing countries: Australia, PNG, Peru and South Africa. The additional demand of four years would be higher than the copper production of all the countries except the U.S. and the USSR.

The annual increase of the world demand for copper will involve the commitment of important financial, human and physical resources in a product characterised by the drastic fluctuation of its prices in the market economies, so it would be a highly risky operation; important increase in capital and operational cost; a shortage of skilled workers in important copper producer areas, developing countries, problems in the relations between the host governments and private companies in developing areas; and environmental contamination restrictions in industrialised countries.

In the final part of this chapter, two of these factors will be considered, the operational and capital cost and their evolution in the last 25 years.

## 2.9 The Costs of Copper

To obtain reliable information on cost has always been a problem in any study of an industry, especially when the activities take place in different countries. Distinct legal, accounting and taxation system affect directly or indirectly the cost, making it difficult to compare scarce information. The conversion to a common currency requires special mention: the rates of exchange in developing countries do not always reflect the real value of national currency in terms of others; inflationary pressure caused by devaluation sometimes determines that they often use indirect instead of direct devaluation; specialised publications have been writing that Zaire and Zambia are the highest cost of the five leading copper producing countries of the market economies but such a result may well be a purely monetary phenomenon. Table 2.10 compares the consumer price index and rate of exchange in both countries since 1970; it suggests that if the official rate of exchange is used in the conversion of the national currencies to dollars, the monetary impact is significant.

Table 2.10

Rates of Exchange and Consumer Prices Indices in Zaire and Zambia  
(1970 : 100)

Years	ZAIRE			ZAMBIA		
	Rate of Exchange	Consumer Price	A/B .100 (a)	Rate of Exchange	Consumer Price	E/D .100 (a)
	A	B	C	D	E	F
1970	100	100	100	100	100	100
1971	100	105.8	94.5	100	106	94.0
1972	100	122.5	81.6	99.9	111.7	89.4
1973	100	141.7	80.5	111.0	118.8	93.4
1974	100	180.5	55.4	111.0	128.8	86.1
1975	100	236.0	42.3	111.0	141.7	78.3
1976	153.5	536.8	35.1	100.1	168.2	59.5

(a) These values are an under-estimate of the real value of the Zairean and Zambian currencies since the decline of the purchasing power of the dollar itself was not considered.

Monetary disequilibria have become a more general problem in recent years and inflation has also been affecting the industrialised countries. Table 2.11 shows the variations in building cost of a new mining plant in the U.S. in 1965-75.

Table 2.11

Average annual increase in cost of construction of U.S. mining and metal projects. 1965-75

	1965-75	1970-73	1973-75
Equipment	4.4	8.3	14.5
Materials	3.4	10.9	20.0
Labour	8.5	9.1	9.8
Composite	5.5	9.4	14.3

Source: British - North American Committee, Minerals Development in the Eighties. Prospects and Problems, 1976.

In the copper industry there are wide variations in cost from mine to mine due to different characteristics of the deposit, mineral, and method of exploitation. The grade of the deposits in the mines in exploitation present great variation from country to country (see table 2.13) and among the mines in each nation. For instance, in Zambia the grade of the four

largest copper mines varied from 3.8 to 1.6 per cent (1). In addition copper can be the main product, a co-product or a by-product when mined. Although most of the copper is obtained from mines where copper is the main product, the nature of the mineral associated with copper results in great cost variations. For instance, in Papua New Guinea, the Bougainville mine has one of the lowest grade of the market economies but according to cost estimations it has the lowest cost due to rich precious metals associated to copper (2) (3). In table 2.12 are displayed some of the minerals produced as by-product in the copper mining operations of the market economies. According to Crowson in the market economies the weighted average cost of production was 82 cents a pound, but by-product credits totalled 43 cents, giving a net average of 39 cents. (4).

Thirdly, costs are affected by the method of exploitation whether it is an open-pit or underground operation. The latter system may result in mining cost 100 per cent higher than those of open pit mines.

Finally, the Zambian and Zairean minerals have to be transported longer distances to reach the ports than the Chilean and Peruvian. Moreover, both Central African producers have had significant problems in their transport systems during the last six years.

Despite the difficulties in obtaining comparable information, some generalizations can be made in relation to the evolution of operational and capital cost; the necessary price to bring on stream a new mine, and an appraisal on the relative cost positions of the copper producer countries.

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- (1) It includes Nchanga Open-pit: Mufulira, Chingola, Lowe and Rokana.
  - (2) C. Radetsky Papua New Guinea: A New Copper Dependent Nation. CIPEC Quarterly Review. April - June 1976.
  - (3) This deposit is also the twelfth most important source of gold in the market economies. Financial Times, August 18, 1978, page 17.
  - (4) P.C.F. Crowson: Copper Production Costs. The Business Economist Winter 1977. Pages 21-37

Table 2.12

Average grade of copper deposits in exploitation; type of operation  
and by-product obtained from copper mines, by countries  
 (in percentage)

Countries	Average Grade %	By-products or Co-products	Type of operation in %		Total
			Underground	Open Pit	
Australia	2.7	Ag,En,Pb	91	9	100
Canada	1.2	Ni,Zn,Au	63	37	100
Chile	1.8	Ag,Mo,Ag	51	49	100
Indonesia	2.5	-	-	100	100
Papua New Guinea	0.6	Au,Ag.	-	100	100
Peru	1.2	Mo	29	71	100
Philippines	0.8	Au,Ag,Mo	47	53	100
South Africa	2.3	-	100	-	100
United States	0.8	Au,Ag,Mo,Zn.	13	87	100
Zaire	3.2	Co,Pb,Zn.	27	73	100
Zambia	2.9	Co.	69	31	100

Source: Compiled from several sources.

#### 2.9.1 Operational cost evolution

In table 2.13 the average operational cost from mining to refining of the competitive copper producers in the world are presented both in nominal and real terms. The deflector used was the U.S. wholesale price index; its disadvantages are evident but the interest is to determine the trend rather than quantify the variations. Except for 1975, the values of the table are based on one source of information to give the maximum possible homogeneity to the datas.

The upward trend can be explained by the reduction of the grade of the mines, growing complexity of the minerals, increase in wages and salaries, energy cost increase and pollution control outlays.

In the past 25 years, more automation and sophisticated equipment have been used to reduce the cost increase rate, and they have proved successful in 1965-75.

Table 2.13

Operational cost of the copper industry nominal and real values  
(cents per pound, real values in cents of 1958)

Years	1953	1955	1960	1965	1970	1975
Nominal	13	18	20	24	28.5 - 32.0	45 - 50
Real	14	19	20	24	24 - 27	24 - 27

Sources: R. Prain: Selected Papers. Vol.IV, 1964-67.

R. Prain: Copper Anatomy of an Industry.

A.K. Beswas: Extractive Metallurgy of Copper.

In mining the most persistent factor has been the reduction of the grades of the deposits; other factors constant, the lower they are the greater the inputs to mine, to mill and concentrate one unit of output. Chapman (1) studied the relation between grades and energy input to obtain one unit of output. Table 2.14 summarizes the result of this study for the case of copper.

Table 2.14

Energy required to obtain one ton of copper from mines of different deposits  
(in thermal units) (a)

Grade of deposit	Energy
2.0	14,350
1.5	16,840
1.0	22,250
0.5	43,140

(a) Rate of conversion, one electric unit = 4.19 thermal units.

At present the energy required to produce one ton of copper, given the average grade of the deposits of about 1%, is about a fifth than that to produce one ton of aluminium. If technology remains constant, the output from a mine of 0.25% copper content would require as much energy as that necessary to obtain one ton of aluminium.

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(1) F. Chapman: The Energy Cost of Producing Copper and Aluminium from Primary Sources Metals Materials. February 1978, Vol.8, pages 107-111.

It was not possible to find information on the evolution of costs of the custom smelters and refineries, but it is replaced by information on prices. This information is not as reliable as that referred to the cost of the whole operation, basically because these prices are determined in long run contracts between the mines and the custom smelters; the characteristics of the contract are extraordinarily complex.

Table 2.15  
Treatment charges, cents per pound, current prices

	<u>Smelting</u>	<u>Refining</u>	<u>Total</u>
Late 1960's	5 - 6	2	7 - 8
1971	5 - 7	3 - 7	8 - 11
1972	8	5 - 6	13 - 14
1973	9 - 10	7	16 - 17
1975	10½ - 12	8 - 9½	18 - 22

Information referred to the early 1960's, suggests that the prices of the custom smelter did not diverge too much from that of the late 1960's. This situation has three different aspects. In the 1960's smelting was much more competitive, the Japanese started to make significant investment and they began to compete with old smelters, some of them already depreciated; moreover the export of concentrates represented a small proportion of the total copper export; and the capacity of smelting exceeded that of concentrates; and the Japanese interested in the entry of this industry charged low prices to promote exports of concentrates. In the early 1970's the process reversed, increasing the capacity of production of concentrates in relation to smelting. The second aspect is that the process began to become more expensive when strict environmental regulations were introduced in the industrialised countries. Finally, apart from the wage and salary increases, the higher price of energy had an important impact on both processes, smelting and refining.

In copper smelting and refining the major possible gains in productivity have been obtained already. The processes are highly automated and according to reliable sources of information, only marginal increases can be expected in the next years.

To reduce cost pressures efforts will have to be concentrated in mining. If it is assumed that a new technological process is discovered to mine the copper, it is likely that its rate of diffusion will be relatively slow in an activity so distributed geographically as this. So,

copper cost will continue its upward trend but possibly at a lower rate of increase.

### 2.9.2 Evolution of the capital cost

The capital cost of the new mines has considerably increased during the last twenty-five years. This situation is explained by several factors, the new sources of supply are located in less accessible areas, the grades of the deposits are lower and their size smaller and usually the minerals are more complex and found deeper in the earth's crust, requiring therefore the removal of each time larger over-burden.

These groups of factors determine that heavier and more sophisticated machinery and equipment is needed. The location of the deposit in more isolated areas imposes higher cost in infrastructure: water supply, roads, ports equipment, social facilities, etc. For instance, in the Iranian project of Sar Chesmeh, the cost of the mine and processing plant was about 1.2 billion dollars and the township and related facilities to give service to the operation has been estimated at about 213 million dollars, that is, 15% of the total investment.

The approximate capital cost per ton for the three basic processes of production are displayed in table 2.16. The deflator used was the wholesale index price of the U.S., which is one of the most important suppliers of equipment.

Table 2.16

Capital cost to produce one ton of copper  
(dollars per ton; real values in dollars of 1958)

Years	1951	1965	1970	1975(a)	1975(b)
Nominal value	1,300	2,000	3,000	5,000	5,500
Real value	1,350	2,040	2,560	2,700	2,975

- (a) It was the lower value quoted by specialised publication. It is referred to a copper deposit of 1.0% copper content.
- (b) It was the value used by the U.S. delegation to the second session of the Intergovernmental Group of Experts on Copper 1977. Probably one of the highest.

Sources: For 1951-1970: R. Prain: Copper, Anatomy of an Industry and Selected Papers, Vol.IV, 1964-67.  
For 1975: British North American Committee, Mineral Development in the Eighties, Prospects and Problems. R. Howard Goldsmith: Prospects for Copper, Mining Magazine, June 1977. UNCTAD Intergovernmental Group of Experts on Copper: Contribution from the U.S.A. February 1977.

Considering 1976 prices the approximate composition of the investment, per ton of capacity, by process of production is as follows: (dollars)

Mining and milling	3,600
Smelting	1,800
Refining	600

The type of operation, open-pit or underground mine, quality of the deposit, etc., considerably affects the investment in mining and milling. If this project is an expansion of an existing operation, the investment may be 20 to 30 percent lower.

### 2.9.3 Approximate Structure of Cost

According to a relatively recent survey, the approximate cost of copper, by process of production, were as follows in 1977 in the U.S.

Table 2.17

Approximate average cost of production, in the U.S., in 1977

Items	Average Cost (in cents per pound)	Percentage
Mining	12	18.9
Milling	17	26.1
Smelting and Refining	23	36.2
Administration	<u>12</u>	<u>18.8</u>
TOTAL	64	100.0

Source: Based on Metals Weeks: The Cost of Producing U.S. Copper: Why Companies are not Expanding. Metals Weeks, June 27, 1977, pages 9 - 10.

According to a report summarized by the same mineral journal, the structure of cost by type of inputs was: labour 34.2%; energy 22.3% and materials and services 43.5% (1). The data refer to 1975-76 and do not include capital inputs.

A reliable source of information provided of the following cost estimate for one developing country.

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(1) Metals Weeks: Summary of the Study of the Chase Econometric Studies on 1975-76 U.S. Cost of Production. The publication does not give the name of the study. Metals Weeks, June 27, 1977, page 10.



	Cents per pound	Percentage
Mining and milling	29	50.9
Smelting	12	21.0
Refining	9	15.8
Administration, supervision, etc.	<u>7</u>	<u>12.3</u>
TOTAL	57	100.0

This cost was the result of a preliminary estimate for a project of investment in a new open-pit of 100,000 tons - year capacity; a deposit with copper content of 1.2%. Prices refer to 1976.

Adopting as a basis the 1976 average capital cost per ton, 6,000 dollars, it is possible to estimate the total cost of a new operation under the following assumptions:

- i) The life span of the mine is 15 years.
- ii) 60% of the investment is financed with a 10 years loan at an interest of 10% The remaining 40% is financed with own capital.
- iii) The investor install the smelter and refinery to service the mine.

In these circumstances the total cost of the new mine is 91 cents. The capital cost can be desaggregate in 18 cents for depreciation and 16 for interest in the first year of operation which gradually decreases. Assuming a 50% tax and a return on capital of 10% after tax, the copper prices would have to average 1.19 dollars per pound to justify the investment.

This price can be reduced if the new capacity form part of an established organisation. An important role would also be played by the by-products or co-products associated with the copper. Reduction of cost can also be obtained by increasing the size of the operation. It is noted, that a mining of 100.000 tons is relatively large when compared to the most significant projects which have been announced or undertaken in the 1970's. Out of 37; only 11 had the capacity equal or greater than 100,000 tons, the capacities of the remaining 26 were lower than 70,000 tons. But the scale of production of the smelter and refinery would be among the smaller.

H. Goldsmith provides information about the prices required for the economic exploitation of a group of mines located in developing countries (see table 2.18). Unfortunately he does not specify the date to which the information refers.

Table 2.18

Cost, capacity and investment for copper projects

Projects	Country	Required price (per pound)	Planned Output Capacity (thousand tons)	Total Investment (US Million dollars)	Cost per ton capacity
Cuajone (a)	Peru	84	154	692	4,500
Tenke Fungurume	Zaire	94	130	700	5,460
Kolwezi	Zaire	90	100	480	4,800
Sta. Rosa	Mexico	90	34	101	2,971

(a) On stream since December 1976

(b) Suspended after spending 200 million dollars.

Source: R.C. Howard Goldsmith: Projects for Copper. Mining Magazine, June 1977.

Another article, quoting the opinion of different copper companies, stated that the future price of copper must exceed 1.00 dollar per pound to justify investment in this industry.

The results can be compared with the average quotations of the LME in 1975 and 1976, 56 and 64 cents a pound, respectively. The difference between current and projected prices and those required to undertake a new project have determined that most of the investment in new capacity have been suspended in the market economies. A substantial increase in prices is needed to justify new investment.

It must be borne in mind that in mining, from the investment decision until the production begins to flow, a minimum of 3 years is required, but on average about 5 years; in smelting and refining this period lasts 3 years in average. The impact of the purely economic factors affecting the decision of investment are difficult to forecast; for instance the overall cost of the investment in Iran was approximately 3 times the original estimates; in Cuajone, Peru, the relation was similar, imposing significant financial problems on the investors. Social and political changes are more difficult to forecast and their implications may be more significant.

Reliable sources of information estimates that the direct world average cost of production was 44 cents per pound in 1976; the standard deviation was 9 cents. The first, third and fourth quartile was 38, 49 and above 53 cents, respectively.

The same dispersion can also be found in analysing each country. For instance, in the U.S. costs varied from about 40 to more than 56 cents with an average of 48 cents a pound and standard deviation of 5 cents.

If the five most important producers of the market economies are classified according to their level of cost, their relative position is as follows: Chile, Canada, the U.S., Zaire and Zambia.

The high costs of production of Zaire and Zambia require further explanations because the mines of both countries have the richest copper content and their production is associated with cobalt and other minerals; the result seems, therefore, a countersense. Three basic factors explain the situation. The first is a methodological one, the cost estimation used the official rate of exchange which overvalues the real value of the national currencies; it is not possible to determine the impact without making arbitrary assumptions, but table 2.10 suggests that while in 1976, the Zairean currency was about 17 per cent higher than its real value but the accumulative effect since 1970 was more than 65%. Second, in August 1975, the Banguela Railways which connected the Copperbelt with the port of Lobito was closed as a result of the Angolan Civil War; this rail line was used to ship between 50 and 70 per cent of the Zambian production and almost the total output of Zaire; both countries had to divert their copper exports to other African ports, using less efficient and inadequate systems of transport; the transport cost of both countries became the most expensive of all the primary copper producing countries. Moreover the transportation problems not only affected the cost of shipment of copper but also the imports; spare parts became expensive and usually were in shortage. The third factor, was that both countries inherited from the colonial era an undeveloped system of education and a considerable shortage of skilled workers; they have to import technicians and skilled labour from industrialised countries; the cost of this process is relatively high.

#### 2.9.4 Cost and rational decisions on production

According to an estimation, an important proportion of the copper supplied to the international market would have as origin high cost producers: the origin of that output would be as follows:

Chile (small and medium size mining)	100,000 tons
Peru	40,000 tons
Australia	40,000 tons
Canada	200,000 tons
TOTAL	<u>380,000 tons</u>

The author added 470,000 tons produced in the U.S. making a total of about 850,000 tons (1). In monetary values of 1977 the cost of this production would be at least 70 - 75 cents a pound.

It is important therefore to define the rational decision about production when the objective of the producer is to maximize profits and foreign exchange.

The simplest situation, a one plant producer maximizing benefits or minimizing losses, ignoring interdependence of producers decision, will be considered first.

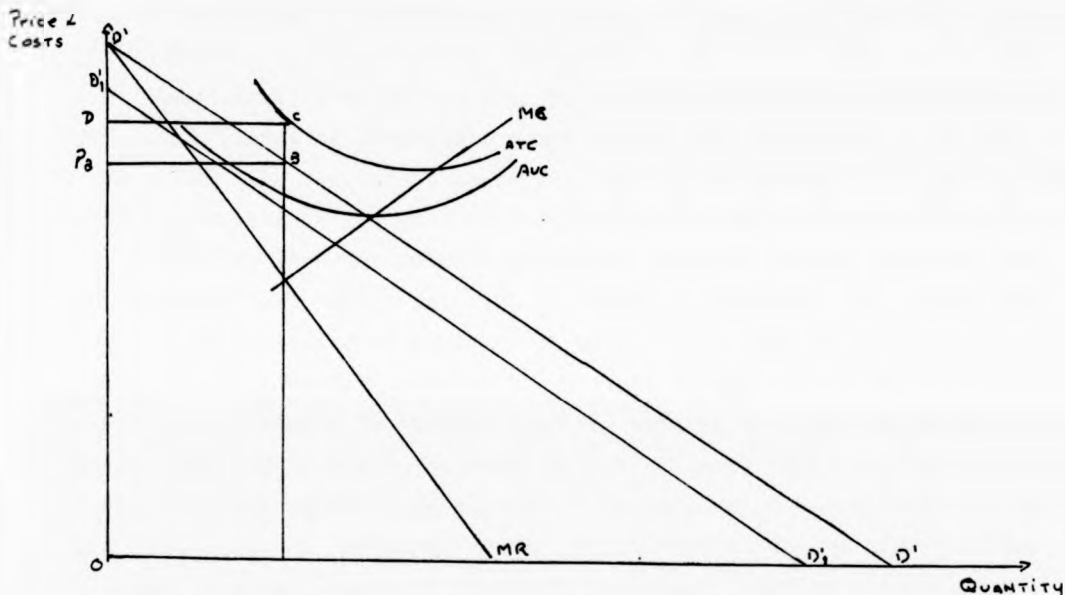
If the price is below average cost, the firm will continue producing as long as the price is higher than the average variable cost. In these circumstances it is receiving an amount which can be used to pay a portion of its fixed cost. If the firms shut down it would be worse off because revenue would fall to zero while expenses would be equal to the overhead cost.

Figure 2.2. illustrates this situation. At price  $P_a$  the firm is making total losses equal to  $P_aBCD$  but in the short turn, other factors constant, its rational decision is to continue in operation since it is not only covering its Average Variable Cost (AVC) but also obtaining a contribution (a positive difference between its price and AVC) to absorb at least part of its fixed cost. However, a further reduction of demand, say to  $D'1 - D1$ , would force the firm to shut down since its contribution is negative.

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(1) L. Vargas. Cost of Production. CIPEC. Quarterly Review. January - March, 1976.

Figure 2.2

The Short-Run Close-Down Position of a Firm

When the firm has multiple plants, the same basic analysis can be applied, but in this case the producer maximizes profits by equating the marginal cost of each of the different plants to the overall marginal revenue.

When the analysis is brought to a more real life situation other factors will affect the decision: the expected prices and cost during the relevant time horizon; the cost of closure and re-opening; the cash position of the firm, the reaction of the government to the reduction of employment and income in the locality where the firm or plant is operating, the degree of vertical integration, etc.

When the decisions of the producers are interdependent, the result may be different. If the producers behave uncooperatively, it is possible that the firm will not shut down even when the price is below average variable cost, because the decision may improve the position of its rivals, while maintaining production it may force negotiations. In this type of situation the results cannot be predicted, without further information as will be discussed in the more detailed analysis of oligopoly in the next chapter.

If the producers maximize foreign exchange revenue instead of profits the firm will base its decision on the price of its exports and the variable cost which involves outflows of foreign exchange. Whenever the firm is obtaining a contribution to cover fix cost its plants will remain in operation.

When rival firms pursue both objectives in an oligopolistic market, the possibilities of coordination may become more difficult. If the firms which have the lowest costs are those which maximize foreign exchange their price preferences will tend to be lower than in other circumstances.

Finally, in order to understand the behaviour of the industry in the international market it would be useful to consider the composition of the cost according to the type of expenses in developing countries, where this distinction tends to be relevant. The Central African producers, and Papua New Guinea must pay expatriate supervisors and technicians and to buy a large proportion of spare parts in other countries, therefore their expenses in foreign exchange tend to be relatively high as a proportion of the total cost. Chile must be at the other extreme, because its requirements of imported labour are relatively small, and it has a relatively diversified industry which can supply an important part of the physical inputs required by the copper companies.

Having reviewed the technology of production, use, demand, and costs of copper, the analysis now moves to some relevant parts of the theory of oligopoly and its application particularly to international cartels.

CHAPTER 3Theory of pure oligopoly, the buyer-seller relationships and international cartels

This chapter is subdivided into three parts. The first deals with the characteristic of pure oligopoly; the most general features of this market structure are analysed, and the factors affecting the coordination of the producers. The second part deals with the inter-relation between the vertical and horizontal structures, that is, the relation between buyers and sellers when both of them have influence in the price at which they purchase and sell, respectively. The third part deals with international cartels.

Copper is an homogeneous product: the industry has had an oligopolistic structure though it has experienced important changes through time; the producer behaviour has been cooperative in some periods while in others, its characteristic has been intense competition. It was considered important to take into account economic theory's suggestions about the factors affecting both types of behaviour, in this market structure, as well as their possible causes and implications.

The second part is closely related to the other two. When the consumers are few they are not passive economic units; they have an important influence on their suppliers. It can not be expected that they will not react to the changes in their input market. In turn the strategy of few suppliers must consider those of their consumers otherwise their plans may lack effectiveness. In the international copper market the most important consumers are net importers and in some cases totally dependent on foreign sources of supply, their strategies have played an important role, affecting both the behaviour and the structure of the sellers' market.

Cartels can be organised in oligopolistic and pure competitive industries but in the latter the possibilities of success are limited as will be seen. In an oligopolistic industry, the cartel is one of the possible mechanisms of producer co-ordination. Taking into account the possibilities of operation in other market structures, the third part of this chapter is an extension of the first but restricted to one particular case, the international cartels. In the international copper market, cartels were organised by the copper producers before the Second World War; however,

explicit producers agreements were also reached in the second half of this century. Moreover, cartels are considered still a strategic option at least by some producers.

### 3.1 The Sellers Relationships

#### 3.1.1 Pure Competition and Monopoly

Under conditions of pure competition the number of producers participating in the market is large and all of them are relatively small. The price is given to the firm which makes decisions on the volume of output and the factors of production it employs only; it is said that in this condition the producer is a price taker. To maximize profits, marginal cost is equated to marginal revenue by the individual producer, but the demand as seen by the firm is perfectly elastic, so marginal revenue is also equal to the price.

The market price is determined by the intersection of supply and demand, the former corresponding to the horizontal summation of the marginal cost curves of all the producers participating in the market. When the market price is above the average cost which includes normal profits, the firm is making abnormal profits. If it is assumed that all the firms are equally efficient, this is not a situation of equilibrium, because new firms are attracted into the market; as this process takes place the market supply curve shifts to the right reducing the market price. This process continues until the firms are earning normal profits and newcomers have no incentive any more to enter the industry.

In figure 3.1a the long run equilibrium of a pure competitive industry has been drawn. The long and short run average costs of each firm are tangent to the price at their minimum points, their long and short run marginal cost are also equal to the price, so that there is no incentive to change the rate of production either.

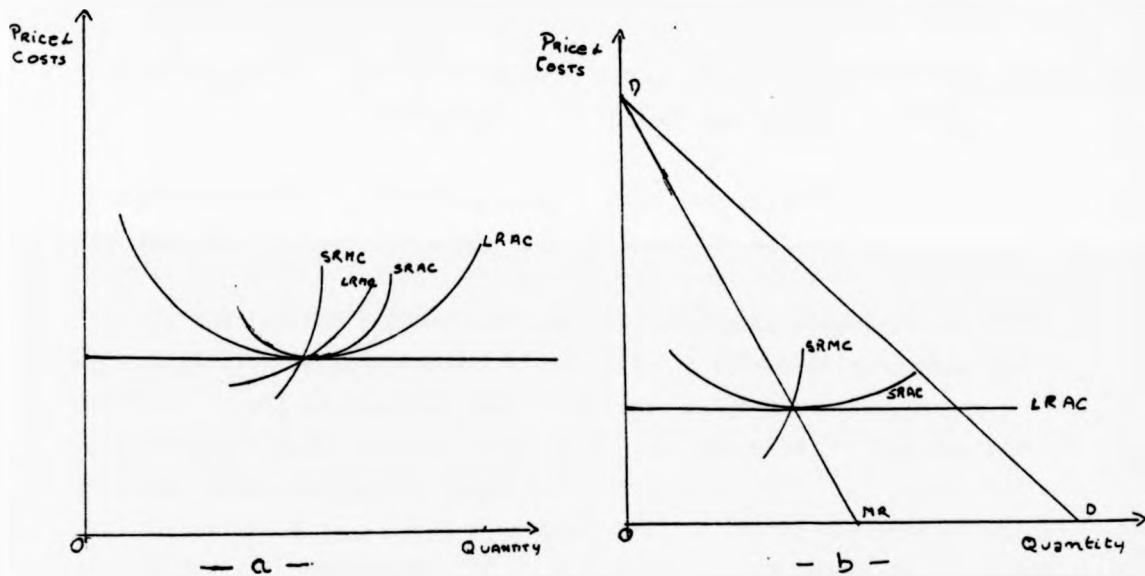
In the case of a monopolist however there is a sole seller in the industry entry to which is blockaded, and by definition there are no close substitutes to the articles he produces. The industry market demand is equal to that of the single seller, and thus to sell an additional unit he must reduce its price. To maximize his profits he produces until marginal cost becomes equal to marginal revenue: the price is always higher than marginal revenue. Since the entry into the industry is blockaded the monopolist is the only producer who can adjust the scale of operation of the industry. In the long run the relation between market demand and cost can be such that he may be (or may not be) producing at the optimal technical scale.



One of the several possible long run equilibria of the monopolist has been drawn in figure 3.1b. This is the most favourable equilibrium to the monopolist but it may well be different to that illustrated in figure 3.1a.

Figure 3.1

Equilibrium under Pure Competition and Monopoly



In the case of pure competition entry into the industry is not restricted at all while in the case of monopolist entry is blockaded. In both cases profits are maximized by equating marginal cost to marginal revenue, but in pure competition the marginal revenue is also equal to the price while in the case of the monopolist marginal revenue is always smaller than the price.

If pure competition could exist in a monopolized industry with production at the same level of costs, then the price would be lower and the output greater than in conditions of monopoly. But in an industry characterized by considerable economies of scale up to a size of operation large in relation to the market, monopoly may result in a greater output and lower prices than in the case of pure competitive conditions.

In both cases the problem of price determination can be solved if one parameter and two variables are known. The parameter is the objective of the firms and the variables the demand and the cost functions.

### 3.1.2 Oligopoly

Oligopoly exists when few firms supply a relatively large share of the market of one industry. The term covers a relatively wide variety of situations each of them with their particular characteristics. Bain (1) gives a general classification of the possible oligopolistic market structures based on the degree of seller concentration, the homogeneity of the product and the high of the barrier to entry into the industry.

- |                                |                             |   |                                 |
|--------------------------------|-----------------------------|---|---------------------------------|
| 1. Pure oligopoly              | (High barriers<br>(to entry | (High concentration<br>(among few sellers | (With a competitive<br>(fringe  |
| 2. Differentiated<br>oligopoly | (Low barriers<br>(to entry  | (Low concentration<br>(among few sellers  | (Without competitive<br>(fringe |

The distinction between pure and differentiated oligopoly is based on the homogeneity of the product. Oligopoly is differentiated when the articles sold in a market have attributes which make them either objectively or subjectively different to the consumers. This chapter will only deal with pure oligopoly.

The height of the barrier to entry will be one of the factors which determine whether the number of producers will remain small or if it will be enlarged depending upon the behaviour of the firms in the market.

The degree of concentration of the producers refers to the share of the market controlled by the sellers and as will be seen is one factor which has significant influence on the mutual interdependence of the producers in the market.

Despite the large variety of situations involved in the small number of producers there are some general principles which can be applied to almost all of them.

The principal effect of fewness is that the marketing activities of the firms are interdependent. The market decisions of each firm have a significant impact on his rivals; it can be expected therefore that each competitor will react to the decision of a firm, reaction which in turn will have repercussions on the oligopolist who made the original move. The firm, must consider therefore not only how it has to respond to the action

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(1) J.S. Bain: Industrial Organisation, John Wiley and Sons Inc., New York, 1968, pages 31 and 32 and J.S. Bain: Price Theory. John Wiley and Sons Inc., New York, 1948, pages 268-270.

of its opponents but also the way in which they may react to its actions. This interdependence involves all the decisions which effect the competitive position of the firms in the market: output, price, sales promotion, advertising, changes in the product, research and development, investment etc.

This mutual interdependence introduces great complexity to the analysis of this horizontal market structure. To determine the importance of interdependence it can be useful to illustrate the results obtained by the firms when they ignore it on the basis of the Bertrand model. It is assumed that there are two sellers of a homogeneous product with identical marginal cost and their market demand is perfectly known by both of them. Each seller adjusts its price on the assumption that his rival will maintain his price. As the products are homogeneous, the producer who sells at the lower price can capture the whole market; this behaviour induces the other producer to undercut the price of its rival. This process continues until the market price is reduced to the marginal cost. Both producers end in a situation in which they can be better off recognizing their interdependence.

It is noted that this result is determined by the pattern of reaction of the rivals; under other assumptions the output result may be lower than in pure competition conditions, as for instance in the Cournot model, in which the producers are quantity adjusters, or in Edgeworth model where the oligopolists are also price adjusters and each one act assuming that the other will maintain its price, but has a difference that the sellers are limited by their productive capacity.

Despite the different criticisms that these models have received, they allow to define the direction in which the producers tend when they ignore their interdependence or when each one intends to obtain advantages at the expense of the other; the result is that they depress the profits of the industry and their own profitability.

The producer-interdependence also determines that the demand of the individual seller is relatively uncertain. This function establishes the relation between quantity sold and price assuming everything else constant. But this assumption cannot be held when the number of firms is small and they are large with respect to the size of the market. Each entrepreneur knows that if he changes his price, the change in the quantity sold which he can expect depends on his rivals reaction. If an homogeneous product is assumed, and there is no mechanism of coordination and/or communication among the producers, the number of possible reactions an oligopolist can expect of his rivals is relatively large:

## I. If he increases the price:

1. The rivals may hold their prices constant, and quantity demanded from the oligopolist who made the change in price will fall rapidly.
2. The rivals may increase their prices so the quantity demanded from the oligopolist will fall but by a much smaller amount than when rivals do not follow.

## II. If he reduces the price:

1. And his rivals hold their price constant, he will experience a significant increase in his sales while the rivals will experience an erosion of theirs.
2. If his rivals match his price, he will experience a small increase in his sales.
3. The rivals may have another alternative reaction namely to undercut the price reduction; if the oligopolist does not reduce his price he will experience a significant drop in his sales. In this case the oligopolist has possible-counter reactions: to hold his price constant, to match the price of his rivals or to reduce his price by a higher proportion.

The mutual interdependence introduces great complexity to the analysis of this horizontal market structure containing elements of uncertainties which are not present in the other market conditions. In pure competition a firm is not aware of the reaction of the competitors while in pure-monopoly conditions there are no rivals to worry about. But there is another important feature of oligopoly which requires to be stressed: there is not a simple relation between the market demand and that of the individual seller. The implication is that the problem of price formation is indeterminate if it is intended to be solved purely on the basis of the demand and cost functions.

Indeterminacy does not mean that there is no solution, but only that it is possible to determine the limits within which the price will fall; and that within this range several solutions can be found. This indeterminacy applies to other market decisions as well, not just price-selling.

To solve indeterminacy two general methods can be used: to make further assumptions about a pattern of behaviour of the producers or to add more information, including data which may be irrelevant to other market conditions.

Both the multiple number of oligopolistic situations and the different method to solve the problems are two of the reasons which explain the large number of theories of oligopoly, but as stated by Scherer it would be misleading to conclude that it cannot be expected to develop theories which predict oligopolistic conduct and performance with tolerable precision "but we cannot expect too much however. The most that can be hoped for is a kind of soft determinism, prediction correct on the average but subject to occasionally substantial errors" (1).

The most important characteristics of an oligopolist industry are four inter-related elements: producer interdependence - rivalry - uncertainty - and indeterminacy in the sense already referred to.

#### 3.1.2.1 Collusion and Independent Action

In oligopolistic industries there are incentives to establish either a tacit or explicit mechanism of coordination among firms participating in the market but at the same time there are forces which make difficult the possibility that such arrangements can be maintained. The most important incentives are basically two: first by reducing competition the firms may operate as a quasi monopoly, increasing the profits of the industry: second, they can reduce uncertainty about rivals reactions and the likelihood of one firm to take detrimental actions against the others.

But there is no easy way to agree on a mechanism of coordination because this means accepting a pattern of sharing the profits of the industry. Moreover distrust and antagonism are factors which are always operating among the sellers and may make them reluctant to define a basis of cooperation.

The alternative to cooperation is independent action: each firm aims to maximize its profits; if the firms are homogeneous in size, market share and cost and ignore their interdependence, a persistent trend to price war may be one alternative result; each seller retaliates against

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(1) F.M. Scherer: "Industrial Market Structure and Economic Performance" page 132. Rand McNally College Publishing Co., 1970.

the market decision of the others, undercutting the price set by the others. The result of such a situation will be detrimental to all the producers but especially to those who have less financial support.

It is generally accepted that a process of learning by experience takes place in the industry and the established sellers will tend to avoid this type of competition whose cost may be excessive for all of them. An alternative result of independent action may be that the established producers accept a given price tolerable for all of them, in order to avoid the uncertain reaction of their rivals, engaging instead in non-price competition as a mechanism to increase their respective market shares. But this is an unlikely pattern of behaviour when the product is homogeneous, because very limited forms of non-price competition are possible.

The mechanism of coordination adopted by the producers may be implicit or explicit agreement. The distinction is important because in some countries explicit agreement to restrict competition is considered illegal, as for instance in the U.S., while in others they are legally accepted with some restrictions. Some of the principal mechanisms of coordination usually found in the industries are the following:

1. In the case of a cartel a group of firms enter into an agreement to set mutually acceptable prices for their products, usually accompanied by output quotas or geographical distribution of the market. The essence of a cartel is that the agreement is explicit and sometimes formal.
2. The adoption of a price leadership whereby the firms follow the policies set by a price leader. Although several forms of price leadership have been distinguished, they can be classified in two groups:
  - Dominant price leadership, when a powerful producer competes with a group of smaller firms which accept the price set by the leader.
  - Barometric price leadership occurs when the oligopolistic sellers accept the price set by one of the firms who takes the initiative in raising or lowering the price, these changes being matched by his rivals. The leader may be the largest producer or the lowest cost or may have been accepted for traditional or historical reasons. The leader maintains its position as long as its market decisions prove satisfactory to the rivals.

3. The adoption of a common formula to determine the price. The most general is the so called cost plus whereby the producers add to the cost a fixed return to capital.
4. It is also possible, as occurs in some raw materials, that the oligopolists decide to set only the quantity they will sell in a period.

3.1.2,2 The Mechanism of Coordination when Entry into the Industry is Barred

Chamberlain stressed the idea that when the number of sellers of a homogeneous product are few, they have equal cost and they rationally seek the maximization of their profits, they will recognise their interdependence and adjust their output in the same way as there were a monopolistic agreement among them (1). The reasoning is simple and direct: each time that one of the sellers undercuts the price of his rivals, they will retaliate due to the losses forced upon them and as the successive price reductions result in the reduction of their own profits, they will finally recognise their interdependence and seek to maximize their combined profits, without necessarily any formal agreement. Several qualifications must be given to this general conclusion.

- i) The larger the number of sellers and the lower degree of concentration the easier it is for the producers to start to ignore their interdependence, conversely the lower the number of sellers and the higher the concentration, the more likely it is that they adopt a joint policy of profit maximization. Suppose for instance a case when there are three firms in the market of equal market share, if one of them intend to increase his share by 20%, it would have to do so at the expense of the sales of each of his rivals by 10%. If it is assumed instead that there are 20 sellers of equal market share and one of them has the same objective, the sales of his rivals would be reduced by about 1%.
- ii) A second qualification is that there may exist a time lag between the moment in which an oligopolist reduces his price and the others react, in which case the price cutter may obtain a net benefit. The net benefit is determined by the larger sales that the oligopolist may obtain compared with the loss that the rivals' reactions will cause. The benefit will depend on, a) the magnitude of the time lag. b) the nature of the rivals' reactions, if they limit their response to match the price, to cut may be

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(1) E.H. Chamberlain. The Theory of Monopolistic Competition. Harvard University Press, page 48, 1948.

profitable, but if they react by undercutting the price of the challenger it is possible that this type of move is rendered unprofitable. c) the net benefit will also depend upon the discount used by the price reducer to evaluate the alternative courses of action.

The inducement to reduce the price also depend on the size of the orders of the buyers and the distribution through time. It seems relatively obvious that an oligopolist will cut his prices when the orders are profitable and large with respect to his capacity of production. The inducement will also be greater when the large orders are relatively infrequent through time, because each seller will tend to consider them as exceptional cases.

One mechanism to prolong the time lag is to concede secret price reductions to the customers. One systematic investigation on this subject was done by Stigler (1), who based his formulation on statistical analysis. He determines how the incentive to cut prices secretly change with the size and numbers of buyers, the number of sellers and the probability that the purchasers who buy from one seller will do the same in the next period in the absence of price cutting. He considered two situations: when each firm can detect chiselling based on its own sales and when there is exchange of information among the oligopolists. For the first of these two cases Stigler built probability tables which show: 1) that the gain in sales from any one rival by secret price cutting is not very sensitive to the number of customers and the probability of repeat sales. The incentive to cut price, defined as the percentages which the price cutter can obtain from its rivals, increases in proportion to the number of firms. 2) The incentive to secret price cutting falls as the number of customers per seller increases. 3) That the incentive to secret price cutting rises as the probability of repeat purchase falls, but at a decreasing rate. A further comment would be necessary to this case, if each oligopolist must make a judgement about the changes in his sales attributable to random variations and other possible variables due to chiselling, it seems relatively obvious that the more stable or the more predictable the market demand of the individual seller, the easier it is to detect cheating. The effect of pooling information is that it reduces considerably the scope for secret price cutting, although the system is vulnerable to false price reports by firms which are chiselling.

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(1) G. Stigler, "A Theory of Oligopoly" page 225, In Brozen Ed. The Competitive Economy. General Learning Press, Pages 215-230, 1975.



iii) The third qualification is that the firms may fail to adopt a quasi-monopoly price if there is distrust, suspicion and antagonism among the rivals. B. Fog analysed the different factors affecting the price policy of six cartels in Denmark and he stated that "each participant seemed to concentrate on gaining advantages at the cost of the others, and be unwilling to give any concession without due reward, and only paying slight attention to anything like maximizing joint profits" (1).

### 3.1.2.3 Cost and Market Share Differences

When the assumptions of equal size and cost of the producers are relaxed, additional relations of conflict among the producers become evident.

Let us consider first the effects of cost in a duopolistic market situation in which both firms produce a homogeneous product and each of them has equal market share and their cost and demand are linear functions. Figure 3.2 illustrated this situation: D-D corresponds to the individual sellers' demand and MR its corresponding marginal revenue.  $MC_A$  and  $MC_B$  are the marginal cost of A and B, respectively. In this case, firm A has a lower price preference ( $P_a$ ) than firm B ( $P_b$ ). Each producer would not be consistent with his objective if he accepts the price of his rival.

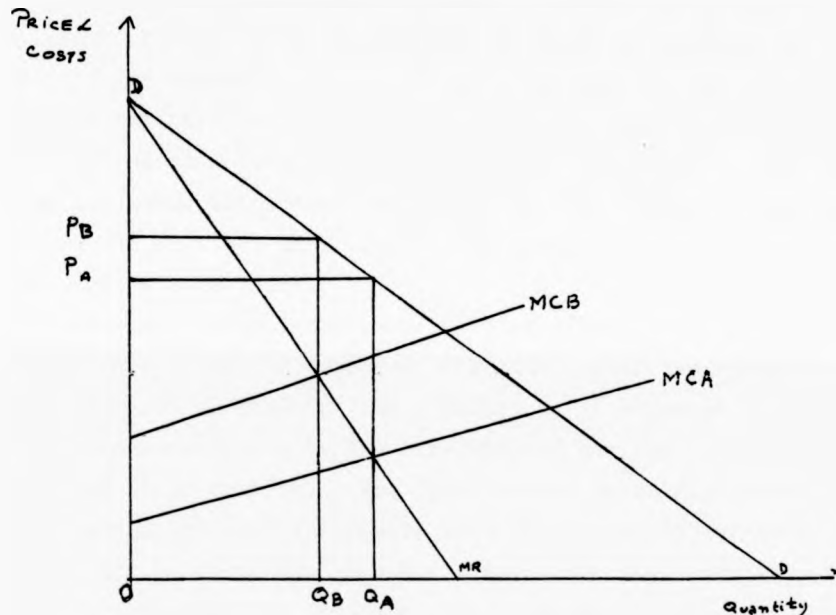
One method of overcoming the conflict is through a collusive agreement maximizing the price of the industry. Another alternative is that firm A imposes its lower price preference on producer B. Firm A is in the stronger position because of its cost advantage since firm B cannot charge a higher price because buyers would shift to the lower price seller. But firm B has an alternative strategy to reduce its price below that of firm A, inducing A to accept a more reasonable position; this option involves the risk of starting a mutually unprofitable price war but it may be a viable option if firm B is diversified and the possible loss obtained from its policy can be offset by profits in other markets. If firm A is also diversified and has financial support to face the price war the final result is unpredictable.

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(1) B. Fog: "How are Cartels Prices Formed", page 20. Journal of Industrial Economics, November 1956, pages 16-23.

Figure 3.2

The Price-Output Decisions of Two Firms with Equal Market Shares  
and Different Costs



In this particular case, firm B has as alternative to hold its higher price, as cost are rising firm A would have to supply additional units at higher cost, while firm B can supply a small market share at a lower cost; and a market equilibrium would be reached at another level of output and price.

The different strategies that the producers can follow do not permit to determine the definite resulting price. It can only be said with certainty that as far as they sell an identical product, the competitive forces will drive them to sell at an identical price, otherwise the firm attempting to raise the price above that of his rivals, will face the erosion of his sales and profits and eventually be driven out of the market in the long run.

Different price preferences may also arise when the firms have different market shares but equal cost. If marginal costs are rising, the firm with smaller market shares has a price preference lower than the firm with greater market share. Conversely, when marginal costs are falling the firm with greater market share has the lower price preference. Other

factors constant, different market shares do not mean different price preference when marginal costs are equal and constant.

#### 3.1.2.4 The Structure of Cost

The relative importance of fixed cost on the total volume of sales has an important role in the ability of the firms in maintaining a price discipline in an industry. Those firms which have processes of production intensive in capital tend to be more affected during the period of recession than those firms which use processes intensive in labour. When successive reduction in demand force cuts in production, the result of this action is to increase the cost per unit, due to the burden of the overhead cost, and to erode profits more rapidly.

If losses are accumulated the financial situation of the firms tend to deteriorate; it can be expected, therefore, that the managers reduce their time horizon to evaluate their decisions as a result of the increasing pressure caused by the necessity of meeting payment independent of the volume of production. The firm becomes more interested in undercutting the price of its rivals in order to obtain larger sales; the competitors in turn have no other alternative then to match the price reduction or to retaliate. Another situation which may tend to occur is that to avoid increase in cost, the firms are reluctant to cut production and postpone the decision; the effect is a reduction of the level of prices and accumulation of stocks becomes an additional source of financial pressure, increasing the inducement of each firm to cut the prices.

In the short term the price can be reduced until it becomes equal to the average variable cost, that is, as far as a contribution can be obtained to cover fixed costs. The more capital intensive the industry is, the lower tends to be the limit to which the firms can reduce the price and the greater the danger of the producer's discipline breaking down. This is particularly important in industries in which the demand is inelastic at all the relevant levels of prices or when the demand becomes more inelastic during the recessions.

It can be generalised that during periods of recession, the capital intensive industries are more aware in reaching agreements to control the output decisions due to the implications on prices that the breaking down of the discipline has, but at the same time the firms have a great inducement to undercut their prices because of the financial pressures.

### 3.1.2.5 Profits and revenue maximizing firms.

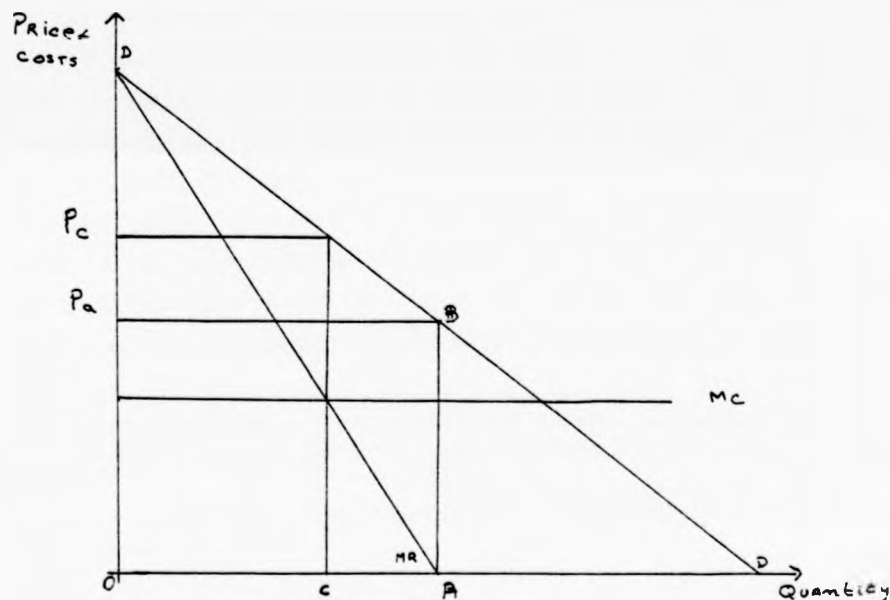
Up to here the analysis has considered that the objective of the firm is purely to maximize their profits, but it may well be that some of them shift their goals to maximize revenues. If the latter objective is limited to some minimum constraint both goals are not necessarily incompatible, because firms in this position require profits to re-invest and expand, if not to pay dividends.

If it is assumed that a firm confront a defined demand, D-D in figure 3.3 the revenue maximizing seller would expand production until the point at which the elasticity of demand is equal to zero, point A in figure 3.3, less production would forego positive marginal revenue, while more output would mean that the additional sales constituted a subtraction to total revenue. If the firm is earning an unacceptable level of profits to meet its payments of dividends and/or accumulation, the output level must be modified so that a higher level of profit can be achieved producing at a point between C and A.

It is noted that the sales revenue maximizer output exceeds that of a profit maximizer, and the price is lower. This is because to maximize profits the firms must equate marginal revenue to marginal cost and the production must be within the elastic segment of the demand curve, except in the highly hypothetical case in which marginal cost is assumed to be zero.

Figure 3.3

#### Profits and Revenue Maximizing Firms



A further change of emphasis to the objective of the firm may be relevant, when the seller seeks to maximize foreign exchange revenue. This may be the case of firms owned by the state in countries whose exports are basically one product, therefore, those requirements of consumer, capital and intermediate goods which cannot be produced in the country must be bought in other nations. In this case, the relevant variables to make the output price decisions are the demand for the product in the export market and those inputs which represent an outlay in foreign exchange.

An implication of the foreign exchange revenue maximizer is that in the short term its output decisions and price preferences should be based not only on the marginal cost but also on fixed cost (1) which under the traditional assumption of profits maximization would not have any role at all. If, for instance, the fixed costs in foreign exchange increase (i.e. wages and salaries of expatriate workers) the firm's price preference will shift to the left along the demand curve.

#### 3.1.2.6 Potential Competition

So far the analysis has considered the oligopolistic structure when entry into the industry was barred. It corresponds now to examine the case when there are possibilities of entry into the industry.

The importance of this process is that in conditions of free entry, the long run equilibria of an industry is its average cost while in market protected by barriers to entry, the established seller can obtain abnormal profits.

Bain (2) defines as the condition of entry into an industry the percentage by which established sellers can maintain a price  $P_o$  above their long run average cost (LRAC) or competitive level  $P_c$  without attracting newcomers. This author denoted  $E$  as the condition of entry so  $E = (P_o - P_c) / P_c = (P_o - LRAC) / LRAC$ . The higher  $E$  is, the more difficult entry is; in a purely competitive market  $E$  has a value equal to zero.

Generally, in oligopolistic industries the established sellers are protected by barriers to entry, but these may not be high enough to exclude the possibility that the number of producers in the market be enlarged.

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(1) This situation may be also true for the revenue maximizer when its overhead cost increase and it is just earning its maximum acceptable profit.

(2) J.O. Bain; Barriers to New Competition. Cambridge, Harvard University Press, pages 4-6, 1956.

In this case, given a long run demand, the established sellers have the option to set a price  $P_j$  (figure 3.4) maximizing their short term profits, but by adopting such a policy they attract newcomers into the industry. Another course of action would be to set a lower price, to reduce the possibilities of new entries. In this case, it is said that the established firms set a limit price which, as defined by Bain "is the highest common price which the firms already in the market can charge without inducing at least one increment to entry - presumably a significant lump increment" (1). They may also have other strategies such as to sell at an intermediate price to regulate the rate of entry into the industry.

In figure 3.4,  $D-D$  corresponds to the long run market demand of an industry,  $MR$  is its marginal revenue and  $LRAC$  and  $LRMC$  the long run average and marginal cost, respectively.

If a group of collusive oligopolists are the only suppliers of a market they would be maximizing their profits  $DECP_j$ ; only if entry is barred at that price. If this is not the situation and the oligopolists had charged a price  $P_j$ ,  $DD'$  may not be their long term demand, whose exact position is relatively uncertain because if entry takes place, their demand curve is shifted to the left of  $DD'$ ; moreover, unless the existing firms reduce their output, the post entry price would be lower than  $P_j$ .

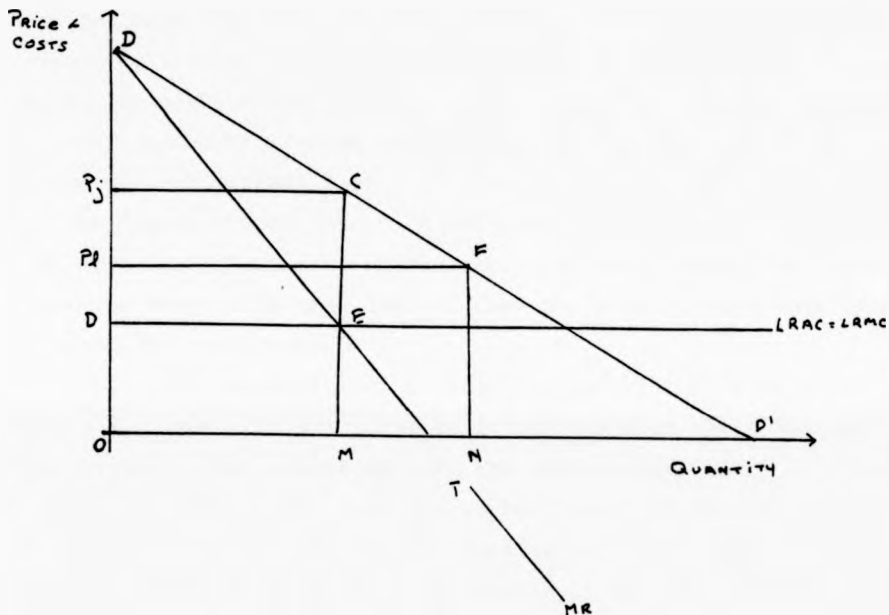
If the collusive oligopolists decide to charge a limit price  $P_l$  their demand curve is  $PLFD'$ ; their marginal revenue is  $PLFTMR$  and their output  $ON$ .

What strategy the oligopolists choose will depend upon the time horizon considered to evaluate the alternatives, the magnitude of the profits which can be obtained from each alternative; the rate at which the maximized profits will be reduced as a result of the new entries and the rate of discount chosen by the oligopolist to evaluate each alternative.

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(1) J.S. Bain: Pricing in Monopoly and Oligopoly, page 454. The American Economic Review 1949, pages 448-464.

Figure 3.4

Pricing to Deter Entry3.1.2.7 The New Entrant's Market Position

A new firm will be established in a market when it is expected that a profit can be made. This will depend upon its cost and demand conditions but in an oligopolistic market, the demand of an individual producer is determined by the behaviour of the rivals, in this case, the existing firms in the market. The established sellers may react to a new firm by increasing, reducing or maintaining their output; unless an assumption about the type of reaction of the established producer is made, the demand and hence the price of the new entrant will be indeterminate. If the existing firms decide to maintain their output at  $OE$ , the demand curve of the new entrant would be  $KD'$  in figure 3.5, but if they increase production to  $OH$ , the new firm's demand would be  $FD'$ .

Most of the studies on this subject set the same assumption made by the pioneer analysts, Bain and Sylos-Labini (1) which Modigliani (2)

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- (1) P. Sylos-Labini: *Oligopoly and Technical Progress*. Harvard University Press, Cambridge, 1962.
- (2) F. Modigliani: *New Developments on the Oligopoly Front*. *Journal of Political Economy* Vol.66, 1955, page 215-232.

called the Sylos-postulate, that is, the existing producers maintain their output. These are two reasons which suggest that in conditions other than rising costs the other two assumptions are less logical but does not mean that they are not possible. If the existing producers reduce their output they experience losses on two accounts: by losing sales, therefore market shares, and by incurring a higher average cost at least in the short term and possibly in the long run if their original plants were of optimal size. If they increase output they incur losses by reducing even more the price and possibly because it may imply bringing less efficient plant into production. Although these two types of reactions seem to be less logical they are possible and must be considered by a potential entrant.

Under the assumption of constant output by the firms already in the market the postentry price can be determined when the existing sellers have absolute cost advantage over the new entrant (1). In figure 3.5,  $D D'$  corresponds to the long run market demand of the industry and  $LRAC$  to long run average cost of the existing producers, which charge the joint profit maximizing price  $P_a$ . The demand of the new entrant and its corresponding marginal revenue are  $P_{ad}$  and  $P_{amr}$ , respectively (both of them were shifted to the y axis to make easier the analysis). The long run average cost of the new firm is  $lrac$  and its profits maximizing output  $OB$ . The post entry output and price of the industry are  $OC$  and  $P_c$ , respectively.

The analysis is valid only under the assumption that the existing producers maintain their output after entry, but in this case, they have as an alternative to increase their output by more than  $CH$ , driving the new firm out of the market. Previously the existing oligopolists had the option to set a price  $P_1$  to deter entry into the industry; the limit price should not exceed the  $LRAC$  of the existing firms by more than their cost advantage over the new entrants.

When the relevant barrier to entry is the scale of production, assuming constant post-entry output by the existing firms, the current price will be affected in direct proportion to the scale of production of the new entrant with respect to the size of the market and in inverse proportion

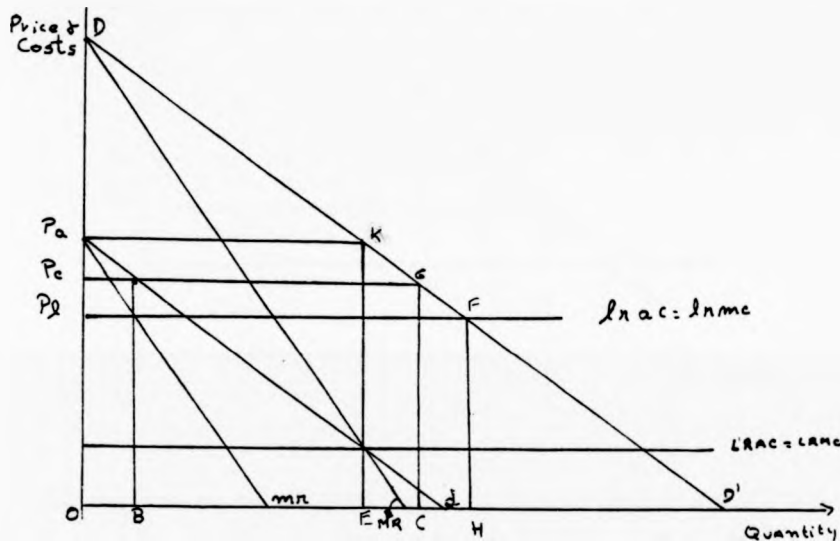
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(1) Based on C.J. Sutton. A Note on Pricing Behaviour with Different Barriers to Entry. University of Stirling. Mimeo.



Figure 3.5

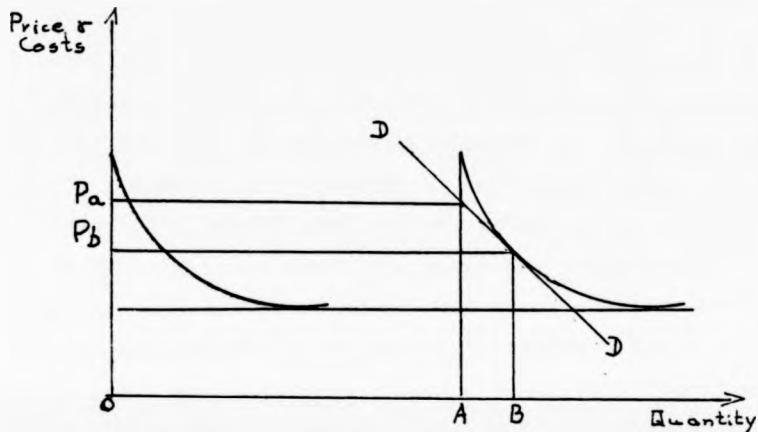
Post Entry Price when the Existing Sellers have Absolute Cost Advantage



to the price elasticity of demand. The larger the minimum scale of the new entrant, other factors constant, the greater will be the impact on the pre-entry price. The less elastic the demand curve the more unfavourable the post-entry situation to both, the newcomers and the existing firms. If a potential entrant has access to a long run cost function identical to that of the existing firms, then although the pre-entry price is above long run average cost, the additional output may reduce the price below that cost, making unprofitable the situation of all the producers in the market; but when the scale of production is important in relation to the size of the market, the potential newcomer may have the alternative to enter into the industry at a scale lower than the one that permits minimum cost. Given the industry demand  $D$  and the cost function of the industry and the new entrant it is possible to determine graphically the price deterrent of the established firms; by sliding  $A C$ , see figure 3.6, parallel to itself in such a way that its zero output coincides with the output of the existing producers (1).

(1) This method is based on Modigliani.

Figure 3.6

Entry at Large Scale of Production

In the market conditions drawn in figure 3.6 a new firm has the possibility of entry into the market obtaining normal profits but using a scale of production smaller than that which permits minimum cost. The effect of entry would be to reduce the market price from  $P_a$  to  $P_b$  and the total output from  $OA$  to  $OB$ . Previously the established sellers have as an alternative option to increase their output beyond  $AO$ , the effect of such action would be to shift the cost function further to the right, and in this situation the potential entrant would not have the possibility of making normal profits in the industry. In figure 3.6 a price below  $P_a$  would fulfil this condition.

It would be easy to demonstrate that the deterrent price varies with the rate at which the average cost of the new entrant falls; the steeper the cost curve, the lower tends to be the deterrent price that the existing producers must charge.

To sum up, in order to deter entry, existing producers must charge a price which does not exceed the long run average cost by more than the height of the barrier to entry, when it is assumed that they will maintain the pre-entry output; the deterrent price should be lower if they contract their output and may be higher if they increase it. The success of a deterrent price policy rests on the basis that the potential entrant believes that the producers will react, at least maintaining their output,

after the entry has taken place. If there are reasons to assume that the firms already in the market will not adopt an uncooperative behaviour, the additional output may not depress the price as severely as to deter entry.

It should be noted that if the existing firms do not react to a new entrant this may be an inducement for other potential newcomers.

Another question of importance is raised by the fact that if the relevant price for a potential new producer is that prevailing after entry, what incentive have the established sellers to set up a limit price policy? Why not reduce the price after the entry has taken place?

A categorical answer to these questions is not possible. Bain explains that the seller already in the market establish a limit price policy because "the entrant is likely to read the current prices policies of the established firms as some sort of statement of future intentions regarding their policies after entry has occurred" (1). But other reasons may also be given: if the current prices are an inducement to invest by outsiders to the industry, it may also be an incentive for the firms in the market; if this is the situation there is a risk of over-investment in that industry. Uncertainty may also have an important role, because if an entrant has financial support, when the established sellers reduce their price to drive it out of the market the new firm has the possibility to reduce the price below their cost, the remaining firms, after a price war, are not necessarily the most efficient but those which have more financial support. Finally, some of the factors which are barriers to entry are also barriers to exit: when the capital invested has not any other alternative use it is sunk: in the short term the firm will remain in the market as far as the price is greater than the variable cost. It is likely that during the succession of time intervals which constitute the long run the existing firms may have no other alternative than accepting the new firm as another established seller as the less unprofitable option.

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(1) Bain: Barriers to New Competition, Page 95.

Summary

The first part of this chapter has dealt with the general characteristics of the oligopolistic market structure; the different motivations of the producers towards co-operation and independent action; the distinct mechanism of cooperation that the oligopolist may adopt and the factors affecting the effectiveness of this system of coordination.

This analysis cannot be considered completed without the analysis of the relations between producers and consumers, specially those which affect the mechanism of oligopolistic coordination.

### 3.2 The buyer-seller relationship

The analysis of the first part of this chapter was based on the assumption that the sellers faced an atomistic buyer market, that is, the buyers had no capacity to influence the out-put prices decisions of their suppliers.

The purchasers may have an important influence on the decisions of the sellers, a situation which may modify some of the results of previous analysis and reinforce others.

Several situations can be considered in the seller-buyer relationship when the objectives of the firms, the demand and cost function are given. They can be classified in two groups according to the types of result which can be obtained: determinate and indeterminate.

i) Determinate results are obtained either when the seller or buyer power is concentrated only on one side of the vertical relationship or in none of them; or when there is bilateral monopoly but the buyer does not use his bargaining power and myopically accepts the price set by the supplier.

Determinate solution can be obtained in all the following situations:

- a) Bilateral perfect competition.
- b) The final seller is a monopolist while his suppliers are a perfect competitive industry.
- c) The final seller is a perfect competitive industry and the supplier a monopolist.
- d) Bilateral myopic monopoly or "when simple monopoly prevails in each market (1).
- e) There is one monopsonist (which may be either a pure competitive firm or an oligopolist in its seller market), competition in the supplier side; in this case it is also included the case in which the monopsonists have the capacity to discriminate among buyers.

ii) Indeterminate results when both sides concentrate bargaining power. In this situation are included bilateral monopoly and bilateral oligopoly. The analysis of this part deals basically with these two cases, included in ii) Bilateral monopoly exists when a monopolist faces a single buyer or a monopsonist. It is assumed that both of them maximize profits. The buyer to be consistent with his objective, does not only take into account

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(1) M.L. Greenhut and H. Olta "Related Market Conditions and Inter-industrial Mergers". The American Economic Review, June 1976.

the opportunities of profits in his selling market but also those which can obtain by influence the price of the suppliers, through variations in the amount of his purchases or simply using his capacity of bargain; as any buyer who behaves rationally, he will take the amount at which the marginal benefit (whether consumer satisfaction or enterprise revenue) derived from the last unit purchased is equal to the additional expense needed to acquire that good. The monopolist supplier to maximize his profits will sell the amount at which his marginal cost is equal to his marginal revenue and will charge the price reflected in his demand curve. Independent price-output dictation by the buyer gives a result different from the price-output set by the monopolist.

To simplify the analysis, it is supposed that the buyer purchases only one input from a monopolist and that the buyer sells the input in unaltered form and does not incur in any other cost.

Under these conditions, the average value product (AVP) of each unit purchased is equal to the price at which the monopolist sell this unit in his selling market so that AVP (see figure 3.7) is also the final demand to the monopsonist in his selling market. The function which reflects the benefit that the monopsonist can obtain from each additional unit he buys is the marginal value product (MVP) which is marginal to the AVP.

In figure 3.7 the costs functions of the monopolist supplier are also described, AC and MC, the average and the marginal costs, respectively.

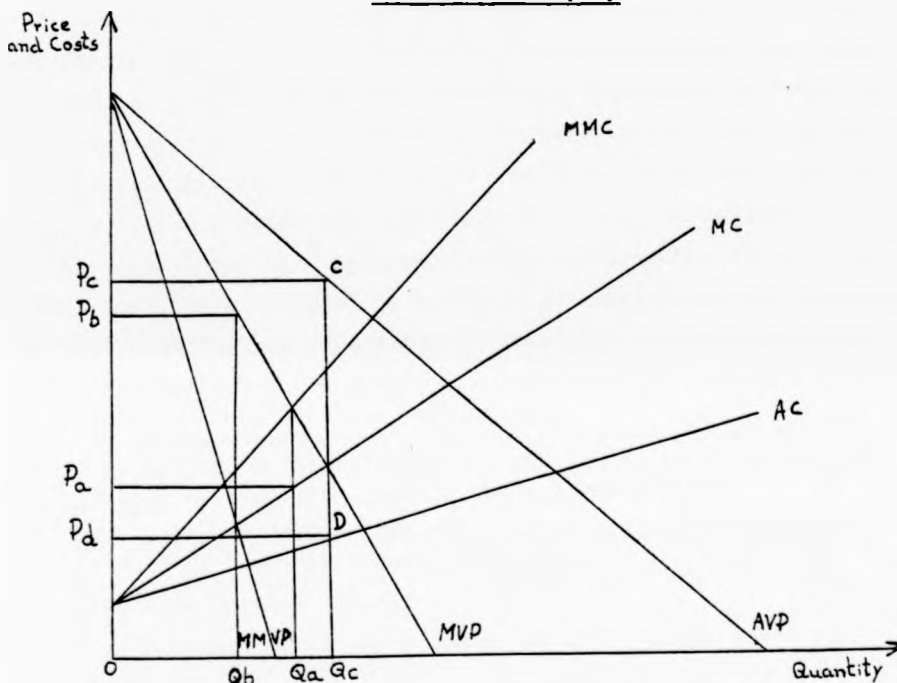
To determine the range of indetermination of this market situation, three different assumptions of possible behaviour of the participants are assumed:

- 1) The input's seller is a monopolist and the buyer behaves as a quantity adapter, he buys until his marginal value product is equal to the price of the input. To the monopolist supplier the MVP reflects the different quantities that the buyer purchases at different prices so that the MVP is his demand function. To maximize his profits he equates his marginal cost to a function which is marginal to the marginal value product of the buyer. The monopolist sells the amount  $Q_b$  at the Price  $P_b$  in figure 3.7
- 2) The buyer behaves as a monopsonist while the supplier of the input as a weak seller. To determine the amount of his purchase, the monopsonist takes into account that he has to pay an additional price as increases the quantity. His marginal benefit is given by MVP in figure 3.7 but his

marginal cost is a function which is marginal to the seller's supply, that is, marginal to the marginal cost. He buys until his marginal benefit (MVP) is equal to his marginal outlay for his purchase (MMC) buying quantity  $Q_a$  at price  $P_a$  in figure 3.7.

3) If both sides decide to maximise joint profits, the quantity exchanged is given by the point at which the marginal cost equates the marginal value product, where the largest joint profits can be obtained. ( $P_c P_d C D$ ). The quantity to be exchanged is  $Q_c$  but the price is indeterminate between two limits along the perpendicular to the vertical axis traced in  $Q_c$ . The lower limit is the average cost of the input producer ( $P_d$ ). The upper limit is the average value product function of the buyer ( $P_c$ ) at which zero profit is obtained by the buyer. The price at which the transactions will be made is determined on the basis of negotiations which in turn, depend upon the strength of both parties, which may vary according to the specific market conditions, the starting point of negotiation and the strategies used by both sides. (1).

Figure 3.7

Bilateral Monopoly

(1) E. Shneither: Teoria Economica, Circulation economica, Plan Economico y equilibrio. Primer Tomo, page 438.

At any other point which is not along the line C-D the profits of seller and buyer would be lower. That line is an Edgeworth's contract curve defined as "the locus of bargaining from which it is impossible to move towards another bargain point, so as to improve the position of one part without worsening that of the other" (1).

If the producer and consumer are not on the contract curve, both of them can improve their profit position but negotiations would be necessary. However, any of the negotiator may reject to make the move. Fellner suggests some reasons: because one side does not trust the other, or he thinks that the suggestion is a mere bluff, or he may ignore the potential profitability of the situation or simply because is a risk averse or for any other reason (2). This type of behaviour can be better understood if negotiation is defined as Professor David does "as the ability to fool the other person" (3). It is possible to disagree with this definition but it reflects the conditions which may prevail during some stages of a process of bargaining.

The profits may be divided by setting a price at which the producer's marginal cost equal the buyer's marginal value product but this will be no stable equilibrium "because of the superior possibilities for either party of independent price dictation" (4).

There is another alternative, that the potential monopolist and monopsonist merger; the output would be the same than when they decide to maximize joint profits, but in this new situation the price of the input may be unimportant; because it does not determine the distribution of the joint profit. The price of the input would have to take into account the maximization of the profits of the firm as a whole. The distribution of profits among the two plants may be a mere accounting problem, but if different taxes affect each plant it would be an important factor to make the decision. In the case that the plants are located in different countries other variables would also influence the decision: political and economic instability of

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- (1) J.A. Morgan "Bilateral Monopoly and the Competitive Output". *Quarterly Journal of Economics*, August 1949, pages 371-391.
- (2) W.J. Fellner: *Prices and Wages under Bilateral Monopoly*. *Quarterly Journal of Economics*, August 1947.
- (3) From J.A. Morgan. *Ob.cit.*
- (4) W.J. Fellner, *Competition among the Few*. Knopf 1949. p.



both countries, rate of exchange, restriction to the repatriation of profits and/or depreciation, etc. In the copper industry these problems were one of the important centre of concern of both the companies and the host governments of developing countries during the 1960's.

The discussion mentioned was mainly related to the case of bilateral monopoly or bilateral perfect collusive oligopoly.

When the oligopolists on both sides act independently the situation becomes more difficult to predict. The combination of price and output will be determined by a bargaining process whose results might deviate considerably from the bilateral monopolist equilibrium.

Generally speaking it can be said that when there are few buyers (sellers) of a competitive raw material (final product) the buyers (sellers) may collude to tend toward a monopsonistic (monopolistic) buying (selling) policy.

The collusive buyers can use any of the mechanism of coordination applied in an oligopolistic horizontal structure, explicit agreement, price leadership etc.

If rivalry develops in the buying market some of the buyers may buy at higher prices in order to secure added supplies at the expense of his rivals; the result will depend upon the secrecy or non-secrecy of the price rise; in the former case the buyer will tend to increase his share in his selling market. In the latter case the buying market will become more competitive and it is also possible, in the extreme case, that a price war may start in the buying market which might lead to a similar result in their selling market.

When the oligopolistic horizontal structure was analysed it was noted that several factors induce the oligopolist to cooperate in order to maintain their prices above the perfect competitive level. But it was argued that there are certain conditions limiting the effectiveness of cooperation. Among others were mentioned the divergencies of cost structure among the rivals, the number of sellers, the frequency of the sales, heterogeneity of the product and channels of distribution used by the sellers, opportunities for secret price cutting.

Generally speaking the most difficult the oligopolistic coordination on one side of the bilateral vertical relation, the greater tends to be the competitive advantage of the other side; and the easier will be to impose its strategy.

When demand is slack or when the capacity of production of the sellers is substantially larger than the demand, the balance of power is clearly in the hands of the buyers, especially the large buyer. It can be expected that the bargaining power reverses to the hands of the sellers during boom periods, but the possibilities of using their strength will require coordination among them.

Not much can be said from a theoretical point of view. The strategy of both buyers and sellers will vary from case to case and the negotiations will obviously pave the way for bluff and counterbluff manoeuvres used by both sides.

Some of the possible strategies of the buyer will be considered. It must be stressed that the large buyer tends to be who may have the greatest possibilities of maintaining the offensive when the collusion of the sellers is ineffective. He will always try to obtain advantages by acting over those factors which limit the coordination of the sellers.

The large buyer tends to concentrate his orders in time, so as to obtain economies of large scale purchase: greater discount rate, reduction of the unitary cost of ordering, reduction in transport cost etc. But there is an additional reason for accumulating orders, namely the possibility that one seller offers him a secret price cut in order to obtain the large order. The buyer will try to exploit this weakness of the sellers, especially when he knows that some sellers have high unabsorbed fixed costs, which is one of the weakest links of the chain.

The buyer is also inclined to spread his orders among the sellers in order to minimize the risk of shortages, but he may tend to shift the distribution of the orders in favour of one seller, in order to obtain more advantageous terms from the other sellers.

It is also possible that the buyer spreads rumours of secret price cutting from certain sellers to increase distrust among the sellers. In the bargaining process the buyer may use as an argument that he has been offered, by certain sellers, some special price concession. Although this practice has been considered dishonest, it has proved to be effective as a mechanism to obtain advantages by the buyers.

There are other ways that the buyer may use to increase his market power. Only some of them will be considered.

The buyer may decide to integrate vertically upstream, producing the whole or part of his requirements of an input. If the buyer's

purchases are equal to the minimum economic scale, he has nothing to fear about the reaction of the sellers. If his purchases represent an important proportion of the economic minimum scale, this factor will constitute an important advantage over his rivals and ex-suppliers. From the point of view of the sellers such a situation represents a focus of potential competition which was already discussed in the limit price theory. They might decide to maintain the price or to reduce it, depending upon the erosion of their profit and the rate of discount they apply to future earning.

If the buyer thinks that there may be conditions permitting the sellers to tend to the point of exploitation of the buyer, (point C in figure 3.7) then he may promote either a programme of substitution of the input under consideration or undertake research to develop alternative sources of supply or to reduce the amount of input per unit of output. These types of situations can be particularly important when exists threat of scarcity of certain input.

As will be seen most of these elements have been included in the strategies of the copper importing countries.

### 3.3 International Cartels

Cartels have been defined as voluntary agreements, potentially impermanent among independent producers which intend to affect the market of a commodity through coordinated action.

The motivation of the producers to coordinate their actions are basically two: to maximize (minimize) their profits (losses) and to reduce uncertainty. Some specialists on cartels have classified the cartels according to the context in which they have operated. Oualid (1) suggests cartels operating in normal economic conditions and in periods of crisis: Stocking and Watkins (2), possibly based on McGregor (3), classified them as aggressive and defensive.

The understanding may be secret or public: written or verbal, it may serve multiple purposes or only one. The essence of a cartel is that it is an explicit agreement, as opposed to tacit mechanism of coordination this means that when there is no organisation and/or no formalities their detection may be relatively difficult.

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- (1) W. Oualid: International Raw Material Cartels, International Institute of International Cooperation, League of Nations, Paris 1958, page 16.
  - (2) G.W. Stocking and M.W. Watkins: Cartel in Action, page 9.
  - (3) D.H. McGregor: Industrial Combination. George Bell and Sons, 1906, pages 116-117 and 136.

The principal factors affecting the price preferences of the producers and the difficulties in reaching an agreement were already analysed, here they will only be mentioned: the number of producers, the homogeneity of the product, difference in level of cost and cost structure, differences in market share and/or the views concerning the future.

The fact that a common policy has to be defined between rivals supplying the same market, and that the understanding cannot be enforced, determine the most important difficulties. But it should be noticed that the non-existence of an understanding has also a cost; each producer must weigh the advantages of being a member of an agreement or to be out of it. This trade-off becomes permanent when negotiations are successful. It is logical to think, therefore, that the producers will be more cohesive when the benefits (the losses) from concerted action are greater (lower) than when they act without it.

Cartels may vary both in form and organisation: for instance the international cartel of the steel industry organised in the 1930's has generally been considered a complex organisation by the specialist on cartels (1); an example of simplicity of operation can be found in the mechanism of coordination adopted by the U.S. copper producers in the 1930's; in a country where cartels are illegal. Its description is given by one of the protagonists, C. Kelly, president of Anaconda Copper Co., in a dialogue with the Counsel of the Committee of the T N E C and Senator O'Mahoney (2), Chairman of this Committee.

Counsel: As a result of that meeting and arrangement, that was undertaken, each producer was allotted a share of the general curtailment, is that correct? Mr Kelly: that is not quite in accordance with my recollection. My recollection is that each producer knowing his current production, knowing the amount of the "Kitty" that was required, knowing what he ought to do and probably what he did, would put down a piece of paper the tonnage he would reduce and Mr Eckent passed the hat and collected it and told us the aggregate.....

Chairman: "In other words there was not an agreement but you came to a common understanding?"

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(1) See for instance: U.N. Department of Economic Affairs. International Cartels, 1947.

(2) T N E C Hearing. Part 25, page 13210.

Mr Kelly: "It was an informal understanding".

Chairman: "As a practical situation you wanted to curtail production and at the same time you were not put in the position of violating the law, so there was no actual oral agreement, as we put it, but you reached the objective just the same".

Mr Kelly: "That is correct".

Chairman: "But you felt it necessary to do that in order to preserve the industry".

Mr Kelly: "Absolutely".

National and international cartels operate on the same basic principles but the fact that the producers are located in different countries suggest that the operations of the members are affected by different institutional, economic, social and political conditions making it, sometimes, more difficult to reach an agreement and coordinate their activities.

There is no quantification of the extent of the international trade covered by cartels before the First World War, but it seems they were relatively important, including a wide range of products. Kypriotis (1) in his historic accounts of international cartels gave about 50 examples of important cartels, but before finishing he states that in the transport industry alone at least 82 had existed.

Estimates of the extent to which cartels controlled world trade in the inter-war period varies widely, basically because the appraisals refer to different periods and use different definitions of cartels: Haussmann and Ahearn (2) estimated that 42 per cent of the world trade was cartelized or under the influence of producers associations between 1929 and 1937. Hexner (3) gives a similar percentage but referred to 1937, while Stocking and Watkins (4) referring their estimation to the imports of the U.S. in 1939 calculated that 87% of the mineral products, 60% of the agricultural articles and 42% of the manufactured products were subjected to cartel regulations. There is no information about the extent they operated in the 25 years after the war. It can only be said that the

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- (1) M. Kypriotis: *Les Cartel Internationeaux*. Librerie Technique et Economic. 1936, Chapter 2.
  - (2) F. Haussmann and D. Ahearn: *International Cartels and World Trade*, and explanatory estimate. *Though Fordman University Quarterly*, September 1944, page 434.
  - (3) A. Hexner: *International Cartels in the Post-war World*, *Southern Economic Journal*, October 1943, page 124.
  - (4) G.W. Stocking and M.W. Watkins: *Ob.cit.*, page 9.

formal public agreements among producers were less important and generalised than in the inter-war period. This does not mean that explicit agreements have not operated, but that the information is not public: in periods of booms cartels seek quasi-monopoly profits i.e. appropriation of consumer surplus, action which is generally socially condemned on ethical grounds.

There are several inter-related causes which determined the emergence of cartels between the wars. All of them are related to the over-expansion of the capacity of production, which took place during the First World War when production was promoted to satisfy the derived demands of war equipment and ammunition of both belligerent parts. After the war a major factor was the creation of a greater number of nations, some of which developed their own plants, and/or allocated resources in other areas in order to secure their supplies. According to Kypriotis, from an economic viewpoint the arbitrary definition, of the political borders and the creation of new states with different tariff systems dislocated some economic units, and the international cartels were a mechanism to re-establish order (1). This process took place in a period of economic expansion stimulated by the process of reconstruction and when nationalist feelings were an important political condition in the decision making process.

When the cycle began to reverse, it began to become evident that there were excess capacity in the raw material industries.

In some cases as an answer to the unbalance between supply and demand governments began to protect their industries which in turn started to dump exports in the international market. This procedure when practised on a large scale not only depresses the prices in the international market but also force their reduction in domestic markets, if the protective tariff is not increased. This process took place in the early 1920's and was the starting point for the creation of association of producers to attempt to re-establish the lost equilibrium between supply and demand.

The crisis disrupted the activities of several international cartels, which could not adapt their operation to the low level of demand, a process of destructive competition began again in some industries. Producers, in many cases, with the active support of their government,

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(1) M. Kypriotis: "Les Cartels Internationaux" Librairie Technique et Economique, 1936.

looked for a mechanism to set up concerted action through the organisation of international combines; in some cases these efforts resulted in the recreation of cartels which had already existed a few years ago.

Although international cartels have been established in almost all products of industry, those in manufactured goods were more prominent than in the raw materials (1) because the latter presents a small proportion of the total trade. Nevertheless, in relative terms international cartels in primary products were more important than cartels in manufactured articles.

Partial explanations of this fact can be given: primary products are generally price and income-inelastic; those products which represent the higher percentage of the value of the trade use capital intensive processes so that variable cost tends to be a small percentage of the total cost; raw materials are relatively more homogeneous than manufactured goods; finally, it will be mentioned here, that commodities exported represent a higher proportion of total output than in the case of manufactured goods.

A general observation found from the review of literature on cartels is that the organisations of producers of raw material adopted output and/or export quotas, sometimes combined with reservation of the domestic market to the national producer; industrial cartels, only exceptionally adopted production control, dividing the export areas geographically sometimes using a system of technical licenses.

### 3.3.1 The Raw Material Cartels: Reason for their Emergence in the Inter-War Period

The causes of the formation of cartels have been extraordinarily variable. It would be important to make a general assessment about the factors determining their formation in the inter-war period, to give later a general answer why the formal public agreements have operated at a much lower extent after the Second World War.

An institutional factor made the emergence of cartels in the 1930's easier. Several governments encouraged the creation of producers' associations in their territories. Japan in 1931, and Italy and Germany in 1932 introduced legislations providing compulsory cartelization. Belgium and Netherlands also approved legislation enforcing cartelization

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(1) Raw materials is used here as a synonymous of intermediate product.

under certain circumstances in 1935. Other European governments also encouraged the creation of national association of producers to regulate output. In the U.S., where already existed a long tradition of anti-restrictive legislation, the American National Recovery Act was approved in 1933, whose aim was the organisation of producers to regulate output under the supervision of the government; the New Deal Codes were in operation for about two years, until they were declared unconstitutional.

The organisation of the producers of the main suppliers countries made negotiation of international agreements easier, it is usually pointed out that they become the necessary complement of the national organisations.

The international cartels organised in Europe have usually been considered as a mechanism to oppose to the increasing challenge of the growing penetration of the U.S. industry in the international market.

In general, it can be said that excess capacity and low levels of profits in a period of low demand strengthen the incentive to create international cartels, to avoid destructive competition or a process of self-depressing price. But excess capacity is also a factor which tends to destabilize the existence of cartels, as was already discussed in the first part of this chapter, the firms have also an inducement to undercut the price of the cartel in order to get more business.

For the 25 years after the Second World War formal public agreements to regulate production became less extended because the market economies experienced an almost continuous growth, interrupted by recessions which lasted relatively short periods, so that excess capacity could be absorbed easily.

Second, in this period new countries have been formed in raw material producing areas, generally exploited by companies of the former metropolis in the case of non-agricultural products; the new governments have been increasingly aware about the condition of exploitation of their resources if international agreement among producers could have been reached, the new governments would have wanted an active participation, increasing the number of participants with divergent interest intervening in the discussion. On the other hand, the private companies were not interested in giving opportunities to the host government to increase intervention. Finally, it will be mentioned here that U.S. companies have had significant influence in the production of inter-mediate products but legal criteria in relation to the participation of the U.S. firms in international cartels



have changed. Despite the fact that cartels have been illegal in the U.S. since 1890 (except in 1933-35), the Webb-Pomerone Act of 1918 authorised the formation of producer association for the sole purpose of engaging in export trade; in 1924 the Federal Trade Commission gave an interpretation for this Act, stating that Association of Producers could reach agreement with non-nationals provided that they did not restrict competition within the U.S. This interpretation was later refused by the Department of Justice whose view became increasingly accepted, restricting the intervention of major suppliers in explicit agreements.

### 3.3.2 Forms of Operation of Cartels

The forms of operation of cartels varies widely. Based on H.W. Macrosty (1) a classification of the most common form of operation, is presented here, according to the degree of control over production and marketing.

a) Cartel of Conditions which stipulate the conditions upon which the business shall be done. They deal with discounts, terms of credits, payment for packing and transport and the conditions attendant on the conclusion of a bargain. A typical example of this type of Association was called the Club of London which grouped some of the principal copper

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(1) H.W. Macrosty. The Trust Movement in British Industry, A Study of Business Organisation. Longmans, Green and Co., London 1907.

suppliers of the international market in the 1960s, the subsidiaries of U.S. companies being indirectly represented. They defined the conditions at which the copper was to be sold to the largest customers, but did not define a price or output policy.

(b) Price fixing arrangements: they regulate the price of a commodity and in some cases the conditions upon which the transactions should be done. Their weaknesses are basically two: it is difficult to agree on a level of price; when it is done the price may be too high, stimulating production of the members of the agreement, if not of outsiders. As market conditions change it becomes difficult to agree on a reduction due to the different price preferences of the members.

(c) Cartels which regulate output: this type of organisation has proved to be more effective, but it is difficult to agree on the basis of the distribution of production because the quota is also a mechanism of sharing the profits of the industry.

The quotas can be distributed based on the historical market share, the existing capacity of production or any other agreed pattern. This decision is adopted on the basis of negotiations. It tends to be more difficult to reach agreement when the market structure of the industry has been relatively dynamic in the recent past, i.e. when the relative position of some members had been declining, they would look for an understanding on the basis of historical market shares, while those which have improved theirs would seek to base it on capacity of production.

The existence of additional capacity of production has proved to be a complicated factor in reaching agreement, especially in adverse market conditions. The firms which have recently invested are always reluctant to accept constraints to their additional capacity because they usually have to meet additional payment of interest, amortization, etc., and therefore they are keen on asking for additional market share while the others are reluctant to make concessions.

The techniques of price determination under quota cartels have varied widely according to the commodity covered, the structure of the industry, organisation of the cartel, etc. Some cartels have provided for uniform export prices to be charged for all the members, given consideration to transport and associated expenses: alternatively, prices were not directly fixed by the cartel, but for the members, allowing differences for quality, special conditions in the individual market, etc. Output restriction was

maintained until the prices reached a desired level and re-introduced if they fell again. Policies of this type were adopted by the zinc and the copper cartel; the latter is considered in detail in Chapter 4.

Another common form of regulation is the allocation of export quotas. When they are fixed without territorial limitations, their operation is similar to the output quota but with one important difference: when the firms associated in the cartel have high overhead costs, the production tends to be higher than sales because the firms seek to reduce their cost per unit and avoid creating problems with the government by additional unemployment. The control of stocks is difficult for the association, and stocks also constitute an additional financial pressure for their holders who have an additional inducement to offer price concessions to their customers, tending to break down the discipline of the producers.

Cartels usually implement their operations by establishing a system of sanctions and compensations. Relatively drastic sanctions were established by the potassium cartel; a transgressor had to pay to the affected party an amount fixed at a maximum of five times the value of the damage, but in the case of a recurrence in the same year, it had to pay ten times this amount. It is noted that the decisions of these payments were adopted by an internal system of arbitration. The 1930 international steel cartel established that the countries which produced more than the quota allocated had to pay a fine of 4 dollars per additional ton while those which produced less received a compensation of two dollars per ton.

Similar measures have been adopted when the members sell below the price set by the cartel. For example, E.E.C.'s steel cartel, Eurofer operating in 1978 established that "any producer caught selling under minimum prices are liable to pay 25% of their value as an advance fine" (1).

(d) Division of the export markets: This system does not directly affect the volume of output and/or sales of the producers, but restricts the sources of supply of the consumers. The producers who have been reserved an area may secure a monopoly position in its territory. The system can be criticised on the ground that while in an internal cartel the government may adopt measures against monopolistic exploitation by introducing a price control, or reduction of protective tariffs, these actions cannot be

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(1) The Economist "E.E.C. Steel" July 15, 1978, pp. 77-78.

adopted against the producer who enjoys monopoly power in one country. This is more important when the importing countries cannot substitute the import for domestic production for technical or economic reasons. From the viewpoint of the cartel, there is also the important disadvantage that the market tends to grow unevenly so that the division of the market tends to become more favourable to some firms than others.

(e) Sales agencies: in this case the sales are taken over entirely by a central organisation which performs the function of marketing. The agency may allocate production quotas (1). Usually this form of organisation operates by setting a price, usually above the unit cost, at which it buys from the members and it sells at the market price. The profits of the associated firms are distributed according to a previously agreed system.

(f) The perfect cartel: This is a theoretical model which assumes that the producer decides to transfer the power of decision on output and price to a central agency whose only objective is to maximise the aggregate profits of the members and that entry into the industry is barred.

To maximize profits two conditions have to be fulfilled, the first is that the central agency must equate the aggregate marginal revenue of the industry to the marginal cost.

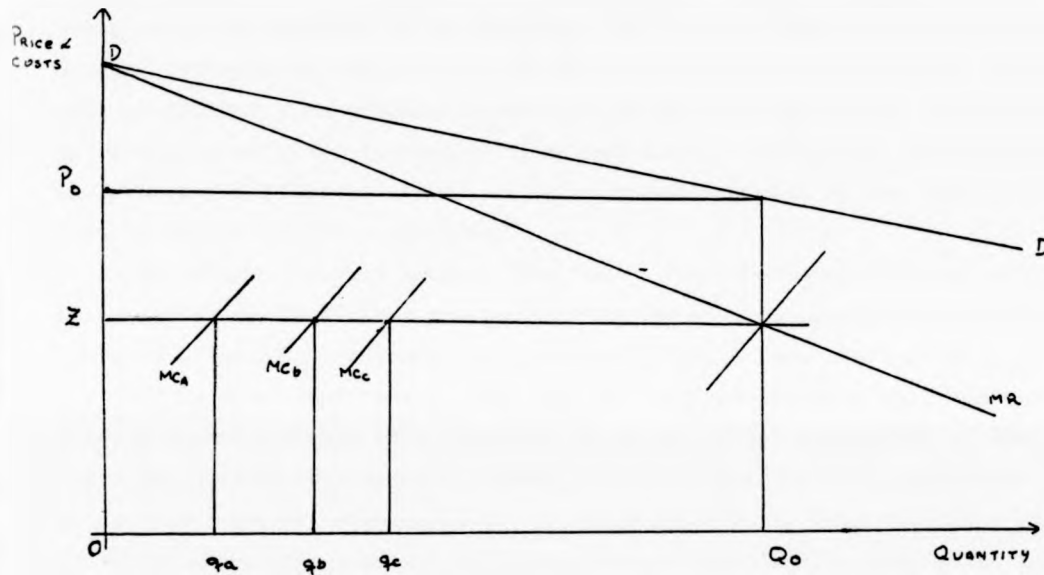
The second condition is that production must be allocated among the plants participating in the scheme in such a way that the marginal costs of the last units produced in each plant are equal both to each other and to the value at which the aggregate marginal cost equals the marginal revenue. Any other distribution of production among the firms will result in a higher aggregate cost. If there is a plant with higher marginal cost than another it is possible to reduce the aggregate marginal cost by allocating additional units to the plant which has lower marginal cost.

To obtain the lowest cost for a given output may mean shutting down the plants in certain firms, either when the cost is too high or when there is redundant capacity. Therefore it is only necessary to operate the number of plants which is consistent with the objective at any output range.

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(1) Before the First World War, the word "kartel" was general restricted to this type of organisation (see for instance F.W. Hirst: Monopolies, Trusts and Kartels. Methuen and Co., London, 1905).

Figure 3.8

Output Allocation in a Perfect Cartel

The profit maximizing output of the central agency is equal to  $Q_0$  in figure 3.8 and the price set by the central agency equal to  $P_0$ . Each firm produces the quota at which his marginal cost is equal to the marginal revenue of the industry. A larger output than  $Q_0$  would add more to the industry cost than to revenue, reducing price and profits. Conversely at any output lower than  $Q_0$  the marginal cost of some plants or all of them would be lower than  $Z$  while the industry marginal revenue would be greater than  $Z$ .

In practice in collusive agreements the distribution of quotas is the result of negotiations and compromises among the participant producers.

The profits of each firm depends upon the quota which it was able to obtain and the production decisions are not made on the basis of the principle of minimizing aggregate cost.

Therefore under collusive agreements the aggregate cost of production of the industry tends to be higher than that of a monopolist.

The perfect cartel can be considered an extreme case of collusion, or as the criterion used when producers of an industry merge, but it does permit to define the principles of distribution of output which should be followed in order to tend to the same level of profits of a monopolist.

In general, collusive agreements do not operate on the basis of the perfect cartel, because it is difficult for the participants to agree on an equitable system of distribution of profits; there is also mistrust among the rival members of an industry, and it is unlikely that firms will want to lose control of their decisions to such an extent and most likely that the higher cost producers would not agree that the output reduction be basically at their expense or that they have to shut down, because they would face the risk that those companies producing most of the output would take advantage of their position.

The above analysis assumed that entry into the industry is blockaded but under other conditions the implementation of a rationalisation scheme would be affected by the entry of new participants into the industry.

It is also important to consider that a firm or group of firms may have an important role in a community in terms of the generation of employment, value added, foreign exchange, taxes, etc. If most of the production reductions must be implemented in one geographic area, then reactions can be expected from the local authorities, social organisation etc, which may result in a higher cost in the long run than the benefits obtained from the scheme.

### 3.3.3 Conditions Limiting the formation of cartels

The operations of an international cartel are restricted by a group of conditions which vary widely from one case to another; some of the most important will be considered here:

- 1) The structure of the industry.
- 2) The elasticity of demand of the industry.
- 3) The existence of the outsiders to the cartel or of a competitive fringe.
- 4) The reactions of the consumers, and their governments.
- 5) The reaction of the government in the countries in which the industry is cartelized.

#### 3.3.3.1 The structure of the industry

Some of the factors affecting the operations of a cartel were already considered in the analysis of oligopolistic structure. Here a generalisation will be attempted in order to avoid repetitions.

Formal understandings to regulate output in atomistic industries tend to be unsuccessful, not only because the large number of producers and their different price preference makes it difficult to reach an understanding but

also because it does not pay the producers to restrict their output. Moreover, in so far as the industry is obtaining abnormal profits, new firms will be attracted to the market reducing prices and profits; or the government of the countries affected will tend to substitute imports for national production. It is likely that in these industries the producers will require an organisation to coordinate the decision and to respect the rules; they must consider also whether the additional benefits obtained with the new infrastructure are greater than the cost.

In this type of industry the cartel tends to follow this general pattern; output is restricted, prices increase above the marginal cost of existing producers and profits higher than normal are earned: new firms are attracted to the market and capacity of the existing producers is expanded; to maintain the price, the cartel must impose greater output restriction among the members; the effect of such measure is to increase cost and reduce profits of the cartelized firms. If prices are to be maintained, as a result of the successive output cut the firms begin to obtain a loss and to be affected by financial pressures, until the situation cannot be maintained any more and the control collapses.

If the firms have unequal costs, the only possibility for the industry to maximize its profits, at least transitorily, is by reducing the output of the higher cost producers as described above in the case of the perfect cartel. Moreover, the system requires restriction of investment. But if the barriers into the industry are small or non-existent, the cartel cannot last for a long period; the new firms will erode the abnormal profits and reduce the price.

In industries where the number of producers are small and conscious of their interdependence and the barriers to entry are high, there exists potential conditions for successful cartelization. In this case, it is likely that the producers were already earning abnormal profits and that they have to change one mechanism of coordination for another, probably because of a change in the market conditions. This does not necessarily mean that the agreement will be stable; the conflict of interests and divergencies of policies persist; moreover each producer, to be consistent with its objective, must permanently attempt to maximize its profits while a restrictive agreement determines a mechanism of distribution of the benefits and sacrifices. It does not follow instead that the producers would be better off being outside the understanding, but that each of them

will tend to accumulate strength to improve its position within it. New agreements are difficult to negotiate because they tend to affect the relative position of the members. The difficulties in accepting the system to the change of conditions tends to erode the basis of this kind of agreement. Moreover, secret price concession is always a possibility open to the rivals; even more, they may be induced by the consumers in order to erode the discipline of the producers.

### 3.3.3.2 Elasticity of demand

The price elasticity of demand for a commodity depends upon the number and closeness of its substitutes, the importance of the commodity in the budget of the customers, and the number of its uses. Out of these determinants the possibility of substitution is the most important.

The second relevant concept is that the elasticity of demand depends upon the time horizon to which it is measured. The longer the extent of the period considered the more elastic the demand for the commodity tends to be, because the easier is its substitution for other articles.

When the objective of a cartel is to increase the price the producer becomes more dependent on the market conditions of substitutes. If the prices are maintained at a high level in relation to the substitutes for a long period, other factors constant, the rate of growth of the article tends to be affected, the typical case has been the oil after the OPEC increased its price.

Conversely, the price increase of a cartelized commodity may raise the price of the substitutes.

There are no general rules which can be applied to every situation. The cartelization of a commodity may be an incentive to cartelize the substitute despite the fact that the producers are independent and/or have no direct inter-relation. For instance, in the uranium industry while OPEC was flexing its muscles in 1972, the governments and uranium producers of Canada, France, Australia, and South Africa (according to Westinghouse, the U.S. uranium companies) formed a cartel, covering another source of energy. The price of uranium rose from \$6.50 in December of 1972 to \$15 in December 1974. \$35.20 in December 1975 and \$41 in September 1976. That is, the increase was as spectacular as that decided by OPEC, generally considered the most successful cartel.



### 3.3.3.3 The proportion of the industry covered by the cartel

A cartel must concentrate a high proportion of the market that the members intend to regulate, in the case of international cartels high proportion of the international trade. But it is noted that the producers who supply their domestic market have the possibility to enter to the international market; they are already producing a commodity and this is one advantage over newcomers if they are producing it in competitive conditions.

Several cartels have covered only a part of the industry, for instance most of those which operated both in the inter-war period and after the Second World War lacked the participation of U.S. producers; a similar situation prevails in the steel cartel operating in the E.E.C. countries, Eurofer, where the European countries who are not members of the Common Market, and the Japanese, do not participate.

The existence of outsiders to a cartel has always been a problem difficult to solve, whatever the objectives of the cartel: to obtain monopoly profits or to restrain the use of excess capacity. The possibilities of success of an international cartel are reduced when the outsiders represent an important proportion of the market, and/or have competitive advantages i.e. low cost and/or have the support of the government of the country where they operate.

The alternative strategies of the member of a cartel to deal with the outsiders are basically four: (1) To induce them to join the organisation. (2) To induce them to cooperate with the activities of the cartel. (3) To confront them in trying to drive them out of the market or to obtain 1 or 2. (4) To dissolve the cartel.

Cooperation of the outsiders can be obtained through direct negotiation, in some cases including the governments of the countries of the members of the cartel. It is also possible to negotiate with the governments of the non-members. If persuasion does not succeed, the alternative is confrontation whose result may be quite uncertain, especially when the outsiders have financial support and/or the support of their government.

The position of the outsiders tends to be relatively favourable; they enjoy the benefit of cartelization without sharing the obligation of being a member of a cartel. So long as the outsiders are small and/or they do not drastically affect the policy of the cartel, the situation may persist for a long period. But when the non-members are major suppliers,

there is no equilibrium, especially when demand is slackening, and, therefore, retaliation by the members of the cartel can be expected or alternatively the dissolution of the cartel with a possible breakdown of the producers' discipline.

#### 3.3.3.4 Reaction of the consumers and their governments

When the basic objective of a cartel is to maximize profits the consumers will tend to react against it and their response will tend to be more effective when the consumers are few and have market power in the commodity in question; the effectiveness of their response tends to increase if they coordinate their policy against the cartel.

The activities of the consumers will be orientated towards the rationalisation of the use of the commodity and substitution of the commodity as well as the destabilization of the cartel itself, i.e. to spread rumours that the members are cheating each other, to increase the number of orders of one of the members of the cartel in order that the others think he is cheating, etc.

Governments of consumer countries usually adopt preventive measures when the country is highly dependent on foreign sources of supply. In the cases of some raw materials the following have become typical: the accumulation of preventive stocks or to financial support for their organisation by private companies, concentration of the purchases in one agency, promotion of domestic production and substitution wherever it is feasible, etc.

#### 3.3.3.5 Reaction of the governments of the countries of members of the cartel

A cartel can affect the price of a commodity through restriction of the sales but in a longer period by reduction of output and employment. The government of the countries of members of a cartel are generally sensitive to the reductions of both variables, for their direct and indirect effects on the economy; the effect may also be important when the trade unions and/or the community affected by the decisions of the cartel, have political and social importance.

#### 3.3.4 Cartel and prices

The price policy of a cartel is determined on the basis of bargaining, usually among firms who have divergent price preferences due to differences in cost, structure of cost, market shares, etc. But as a general rule, the

price tends to be higher than those which would prevail without an understanding, due to two reasons: the firms were already maximizing their profits so the cartel is a mechanism to improve their position; second, the members of the cartel are always facing the alternative of acting independently, so that if they remain within the organisation it is because they think they are better off.

It is usually said that the prices will tend to be set at a level which covers the cost of the highest cost producer within the cartel, and it is added that this producer would be eliminated under competitive conditions or that under a monopolistic combine with unified management his plants would not be used.

It is not necessarily true that the price will be fixed at such a level, it may well be below the costs of the highest cost producer but he has no other alternative than to accept this situation. It is not necessarily true either that the highest cost producers would be eliminated under competitive conditions, but rather the firm with less financial support, especially if the producers adopt destructive competition as a mechanism of confrontation. Finally, under a monopolistic combine with unified management it is possible that the plants of the less efficient producers may not be used, but this does not necessarily mean that the price of the combine will be lower than the price of the cartel.

### 3.3.5 Cartels and excess capacity

Excess capacity can be reduced through the elimination of the less efficient producers. But the market system may not operate in such a direction in some circumstances, in a period of economic distress or when the less efficient producers have financial and/or political support, etc. In the international market some governments may protect the less efficient producers through tariff, subsidies, freight allowances, or other mechanisms; this type of measure enhances possibilities of lowering the export price through dumping to absorb overhead cost and/or create the conditions of starting the negotiation of an agreement: the protected firms may considerably increase their bargaining power.

Cartels do not eliminate excess capacity, but distribute the burden among the members through the allocation of quotas and systems of fine and compensation. This is not a stable solution; when the restriction has to be imposed for the relatively long period, the inducement of the firms to break down the agreement to improve their individual situation tends to

increase. The mere existence of the inducement does not necessarily mean that the producers will break-down the understanding; it has to be stressed that the removal of the coordinated restrictions will not reestablish an equilibrium, or a system of workable competition.

It is usually stated that cartels promote excess capacity. Two variants of this argument will be considered. The first is that some members of the cartel invest to improve their bargaining position during the renewal of the agreement and to obtain greater quotas. If it is assumed that the producers behave rationally they will expand their capacity only if the additional benefit from the greater quota is greater than the additional cost to obtain it. But, as an old report of the League of Nations states "experience has shown that when the majority of important cartel comes up for renewal, the firms which speculate on an increase in their means of production with a view to obtaining a higher quota have failed to achieve their end, and that salutary example has, to a large extent, prevented the repetition of such speculation" (1). Moreover, when the producers are few and their decisions inter-dependent, the inducement to invest can be reduced; in this respect there is important testimony from Mr B.T. Stannard, President of Kennecott Copper Co., in one of the TNEC hearings, where he is referring to the International Copper Cartel organised in 1935, in which the U.S. producers were participating through their subsidiaries in other countries. "We hoped through arriving at a common understanding that we would avoid additional plant installation because if one party increases its plant - putting more capital - then the others would have to follow and we would finally come down to a prive of copper abroad which will be ruinous to all of us; the five main participants probably have in the neighbourhood of half a billion dollars tied up in the copper investment in Rhodesia and Chile" (2).

The second variant of this argument is that the high prices charged by the cartel attracts newcomers into the industry. Some of the basic aspects to be considered were already analysed in the first part of the chapter. Here it will be pointed out that this factor may be more important in the international market because high prices create the feeling of dependence on foreign sources of supply; the government and consumers affected may combine efforts to develop alternative sources of

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(1) League of Nations General Report on the Economic Aspects of International Industrial Agreements, 1931, page 20.

(2) TNEC Hearing, Part 25, page 12215.

supply. But it is wrong to think "that potential competitors are always on the qui vive, ready to spring upon the flanks immediately the cartel begins to exploit the consumers" (1), or that their effort will be always successful. The decision of investment involves the analysis of a great number of factors; the pre-entry situation attracts the attention to the industry but the barriers to entry, the reaction of the existing firms, and the stability of the cartel, all have a significant role. Plummer wrote before the development of the limit price theory "monopolistic combines will be seriously threatened by competition only (a) if the chances of successful competition and perspective of profits are good, and not likely to be merely temporary: and (b) if adequate capital can be brought together by potential competitors in sufficiently large, well managed units, and without causing such a fall of prices as to eliminate profits and (c) the combine is not already in exclusive possession of some essential or essentials of the industry (1).

### 3.3.6 Cartels and tariffs

Tariff and international cartels are closely related. Both of them are mechanisms which regulate trade, despite their different nature and objectives. The creation of cartels may cause the modification of the tariff in one or more countries; in turn the modification of tariffs may create the conditions for the organisations of cartels. International cartels have to operate within a structure of tariffs whose modification may affect the relative position of the members of the cartel. The inter-relations are multiples, only some of them have been considered in this general analysis.

Among the cartels organised in the inter-war period several of them were the result of protective commercial policies; and even before McGregor wrote "without tariff at all, it is much to be doubted whether international agreements could arise" (2). But the relation is not mechanical. There are several cases in which tariffs were imposed on important markets but international cartels were not formed. Conversely, numerous cartels have been formed without changes in the system of tariffs.

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- (1) A. Plummer, *International Combines in Modern Industry*, Pitman, London, 1951, 3rd Edition, pages 187-188.
- (2) D.H. MacGregor *"Industrial Combination"*, George Bell and Sons, London 1906, page 120.

However tariffs or other import restrictions can be connected with the more general cause of the formation of cartels, i.e. excess capacity of production. The establishment of a tariff limits the market of the producers operating outside the protected area; within it, the less efficient producer may survive and/or new capacity may reach the market. The impact of protective measure on the suppliers of the international market will be greater the higher the idle capacity of production; the effect will be more important if the producers within the protected area start to dump export in the international market.

Other factors constant, these situations may reinforce the conditions of over capacity of production and may lead to the creation of international cartels, but the result may well be other, for instance a process of cut-throat competition.

Tariffs have also played an important role in the negotiations of international agreements. The establishment of a tariff may improve the bargaining position of the producers within the tariff to negotiate an advantageous quota agreement. One of the typical cases is the import quota negotiated by the British Iron and Steel Federation with the European Steel Cartel in 1935; the members of the cartel were asking a quota of 850,000 tons in the British market; while the British offered a quota of 643,000 tons in spite of the facts that the import were 912,000 the year before; the British Government increased the import duties, on average from 33 to 50 per cent ad-valorem. One month later an agreement was reached on the basis of a quota of 650,000 tons for the first year and 525,000 tons per year thereafter. The British Government reduced the import duties to the former levels.

A tariff tend to reserve the entire or part of the domestic market to the national producers; an agreement may reserve that market to a producer which is not located in the consuming country. The difference may be important because in the former the government has other mechanisms to regulate or influence the operation of the national producers while in the latter the mechanism may be more indirect.

In periods of recession the establishment of a tariff may improve the cost position of the national producers allowing further utilization of the productive capacity; but this may be at the expense of the position of the more efficient producers which may experience an increase of their costs; if the imports of that country originate from many producers, the

additional cost can be absorbed by all of them, making negligible the impact on any single exporter; but this may not be the general case.

When the agreement among producers reserves the domestic market to the local suppliers, it reinforces the imposition of a tariff. The converse case, that the conclusion of an agreement was reinforced by the imposition of tariff is difficult to sustain. But the direct or indirect participation of the governments in the negotiations of international cartels may suggest that their policies if not support at least accept the operation of those agreements.

Finally, the fact that international cartels have to operate within a tariff structure determine that changes in import restriction and/or regulation may not affect directly the agreement; this may be particularly important when these changes take place in consuming countries which are important to the members of the cartel. It is likely that the new market conditions affect the participants unevenly, a situation which may lead to pressures to modify the agreement, that is, the basis of the cartel. If the members of the cartel are already operating at a low level of their capacity the understanding may collapse; disruption of the cartel may be the result of renegotiation when there is a great deal of friction and/or distrust among the members or when the understanding is relatively complex so that the change in one clause lead to modification of others; a situation of this type determined the definitive suspension of the activities of the Copper Exporter Inc as will be seen in the next chapter.

### 3,3,7 The instability of cartels

The instability of cartels may be considered from many viewpoints and there is always the possibility that the consideration of some factors and the non-inclusion of others may result in an analytical bias. This is important because some of these conditionants may operate in one context and not in others. A general approach will be attempted with the risk of some repetitions.

Cartels are generally transitory agreements due to last for a given period and usually, the understanding leaves open the possibility that one or more member may withdraw. They are not intended to be permanent.

The empirical evidence supports the idea that they last for a short period. In the inter-war period 45 international cartels operated in the raw material field, only 5 lasted more than 6 years but most of them were

dissolved by drastic changes in the market conditions, the crisis, and re-organised a few years later. There is no systematic compilation about the cartels which have operated after the Second World War, but none of the publicly known producer's international agreements has had a long life. It is possible that this conclusion is biased in that it refers only to what is publicly known but a rough consideration on a case by case basis does not suggest a different conclusion. Moreover, studies of the operation of national cartels have drawn similar conclusions, i.e. F. Voight in his analysis of the German experience (1) or the multiple studies on "public conspiracy" in the U.S.

The instability of cartels is determined by the rival relations of the producers and their different market position and operational characteristics which in turn determine different price preferences and expectations. They are disputing the share of a given level of profits in a market condition and each of them has to be consistent with his objectives.

However, the implications of the formation of a cartel are not independent of the structure of the industry: in a pure competitive market a cartel is due to last for a short period as was already analysed; in an oligopolistic industry the situation may be different depending upon the character and degree of the producer interdependence, and the competitive position of the members of the industry.

It can be suggested that cartels will tend to be more stable in oligopolistic industries, the more its structure approaches monopoly conditions: the lower the number of firms; the more homogeneous the product, the less different the level and structure cost; the more alike the market share of the members; the lower the short and the long run elasticity of demand; the more reduced the competitive fringe and the more effective the restriction of entry. This is assuming that all the firms of the industry are members or potential members of the cartel, the existence of outsiders may also affect the stability of the cartel.

In general, a cartel will be the more stable, the greater the control of the market by the participants; the more homogeneous the factors affecting their output and price determination and their responses to variation to the market conditions. The influence of these factors were already

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(1) F. Voight: "German Experience with Cartels and their Control During the Pre-War and Post-War Periods, page 200 in Perry Miller Ed. Competition, Cartels and Regulation.



considered in this chapter; it would be necessary to insist that they also affect forms of coordination, other than cartels.

The instability of cartels has usually been connected to chiselling or secret price concessions to the consumers; for example Baird after considering the cause of these types of reductions he states "if the OPEC cartel goes the way of most cartels, individual members will increasingly cheat on their production quotas, and the world crude oil price will fall" (1).

This suggestion goes too far; other factors have determined the disruption of cartels and chiselling has not always been the most important. However, in the first part of this chapter, price concessions were connected to all the forms of oligopolistic coordination and not only to cartels. Price concessions are obviously a factor which may affect the effectiveness of the operation of cartels, but the type of organisation adopted by the producers may reduce the probability of chiselling and the system of collection of information, generally set up by the cartels, may ease its detection. The use of fines and penalties may operate in the same direction. Moreover, the cartel can reduce the price of the product as a counter measure or as a mechanism to re-establish producer discipline.

During an economic recession the cartels tend to be less stable. Several factors interact simultaneously in the same direction. Firstly, the more abrupt the decline in demand the more likely it is that disagreement will arise among the members of a combine because the producers have divergent expectations and/or because the suppliers and their relevant markets are affected to different degrees by a recession. The lack of agreement may result in the decisions on output curtailment to be postponed or in the adopted cuts being too small in relation to the reduction of demand; when the cartel sets the price, the disagreement may cause the price to be maintained at a relatively high level, stimulating production. However, uncoordinated action will cause a significant fall in the market price, forcing the sellers to adopt drastic decisions.

Secondly, during a recession the members of a combine have to bear the cost of idle capacity, giving higher total average cost (the fixed costs spread over a restricted number of units). The more capital intensive the industry which is facing a persistent decline in demand, the more

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(1) C.W. Baird: Prices and Markets: Microeconomics. West Publishing Company, 1975, page 147.

rapidly the producers will reach the level of output at which the suppliers incur heavy losses, and their financial situation deteriorates. In these situations each seller has a greater inducement to under-cut the price of its rivals to obtain additional business, to reduce average cost. Recognising this tendency, it must be pointed out that when the producers are few and their decisions inter-dependent, the sellers tend to exercise restraint in their price decisions since they face the risk of a total breakdown of the producers' discipline situation in which the price may rapidly be reduced to its lowest limit, ie. marginal cost, in a very short period. This risk stimulates the producers to persevere in cooperative solutions, and it may reduce, even nullify the inducement to under-cut prices.

Thirdly, any additional adverse change in the market conditions during a recession tends to reduce the stability of a cartel. Factors such as the entry of new firms into the industry; the arrival of new capacity (brought about by members of the cartel or outsiders of the combine); changes in the system of tariffs; or the persistent unco-operative behaviour of an outsider of the cartel. These type of situations on the one side introduce new restrictions to the members of a combine, making more difficult the adjustment to adverse market conditions, on the other side they tend to affect the bargaining position of the producers; the typical example is the firm which has been protected by a tariff and can dump exports in the international market until its terms are accepted by the members of the cartel.

Finally, during a recession the firms have to reduce production, and usually they introduce programmes of rationalization and changes in their organisation. Such measures cause unemployment, and in some cases reduction of wages and salaries, which in turn may cause reaction of the unions, local communities and governments, restricting even more the capacity of adjustment of the firm to the recession.

From this analysis it does not necessarily follow that independent action will improve the position of the producers; but this option may be chosen to improve the bargaining position within the industry. But this course of action involves the risk of breaking down the discipline of the producers and even of a price war.

When the cartel aims to stabilize the price of a product or to set a quasi-monopoly price, in more normal market conditions, they are less affected by instability; they are better able to adapt to changes. They

also restrict output but obtain a higher benefit and possibly enjoy a better financial position; the government and local communities can be compensated directly or indirectly for the adverse effect of the lower level of production or employment. However, substitution, possible entry of new producers, expansion of the marginal producers, reduction of the rate of growth of the demand and possible reaction of the consumer to the higher prices, may all create a relatively dynamic situation which may determine further reductions of output and higher cost levels, which erode the colluded benefit and eventually destabilize the cartel. This is more likely in competitive industries and must not be generalised to every case, that is, it can not be drawn as a conclusion that every cartel has a disastrous fate; this would imply an assumption that the decision makers are irrational in becoming members of cartels as they do not consider the restrictions they face in the definition of their strategies and implementation of their policies. In a cartel the decision making system is based on negotiations and has inflexibilities; but it does not follow that a cartel is a static entity without any capacity of response to changes in the market. A cartel may give strength and permit the definition and implementation of strategies and policies which are not possible for any individual member. The alternative to a cartel may be independent action which may result in even more restrictive operational conditions for some firms, especially when the less efficient producers are protected by tariff or other imports restrictions.

CHAPTER 4THE INTERNATIONAL COPPER CARTELS

This chapter deals with the cartels which operated in the international market since the early developments of the industry in the 19th century.

In the period covered by this chapter the technology and organisation of the industry experienced drastic changes. It was in the last 20 years of the 19th century and the first 20 years of the 20th century that the basis of the modern technology were introduced (1): almost in the same period the organisation which dominated the industry until the 1960s was set up.

Table 4.1 displays the average copper production by decades in the 19th century. In that century copper production grew by 3.5 per cent per annum but in the first half at a lower rate (2.9%) than in the second (4.6%).

The increase in the rate of growth can be explained by changes in demand and supply. The dynamic effects of the industrial revolution with its increasing requirements for supplying the demand for transport, urbanization, machinery and equipment and, in the last two decades, the incorporation of electricity brought about new uses of copper. The expansion of copper production was the result of the opening-up of the new mines first, but since the 1880s it was the product of changes in methods of production.

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(1) Important modifications in the methods of mining and processing the mineral were made in the first seventy years of the nineteenth century. One of the most important changes was the introduction of dynamite which replaced the black powder giving greater effectiveness and making the process of earth removing much easier. Other modifications were the use of compressed air for drilling and the introduction of steam power for lifting. But the technological innovations which were going to establish the basis of the modern copper industry (bessemering, electrolysis, mass mine production, flotation) were introduced between 1880 and 1910.

Table 4.1

<u>Production of copper per decade and the four most important sources of supply</u>								
Decade	Average Annual Production	Per Cent Increase	First Producer (%)	Second Producer (%)	Third Producer (%)	Fourth Producer (%)		
1801 - 1810	16,507	-	U.K. 40	Russia 18	Japan 17	Chile 9		
1811 - 1820	17,096	3.6	U.K. 44	Russia 18	Japan 17	Chile 9		
1821 - 1830	24,806	45.1	U.K. 45	Japan 16	Russia 16	Chile 11		
1831 - 1840	33,060	33.3	U.K. 44	Russia 14	Chile 14	Japan 12		
1841 - 1850	44,789	35.5	U.K. 33	Chile 20	Cuba 13	Russia 11		
1851 - 1860	68,649	53.7	Chile 32	U.K. 21	Russia 8	Cuba 7		
1861 - 1870	107,245	51.4	Chile 44	U.K. 11	U.S.A. 9	Spain 8		
1871 - 1880	129,133	23.9	Chile 36	Spain 15	U.S.A. 15	Australia 9		
1881 - 1890	225,715	74.8	U.S.A. 32	Spain 22	Chile 16	Germany 7		
1891 - 1900	376,346	66.7	U.S.A. 52	Spain 15	Chile 6	Japan 6		

Source: Alex Skelton: *Copper*, Op.Cit.

#### 4.1 The Two Associations of British Smelters

In the 18th century the U.K. became the largest producer and consumer of copper (1); it also controlled a substantial part of the international trade. Its major overseas markets were the West Indies, America and at a lesser extent Africa and India; from the 1770s, Holland and Germany.

The major sources of production were Cornwall, Ireland and the Isle of Man.

Smelting basically consisted in alternative processes of roasting and furnace. 30 to 35 tons of coal were required to obtain one ton of copper. This situation largely explains the location of smelters in an area where coal was abundant, South Wales (2). Swansea had as a particular advantage that the ships transporting the copper ores could return with coal.

In 1750 the Associated Smelters of Bristol and Swansea was organised. The miners, smelters and manufacturers were members of the organisation. The Association fixed the prices of copper at different stages of production and it divided the market among the members.

(1) For an analysis of the UK copper industry see R.O. Roberts: *The Development and the Decline of the Copper and other Non-Ferrous Industries in South Wales*. Transactions of the Honourable Society of Cymmrodorion, 1957-58, and *Copper and Economic Growth in Britain 1729-1784*. Journal of the National Library of Wales, Vol. X.

(2) D. Williams: *A History of Modern Wales*. Pages 189-190, 225, 288. John Murray, 1950.

The high prices charged by the Association induced the semi-manufacturers of Birmingham and London to invest in smelters. This entry was possible when a new rich copper vein was discovered at Anglesey.

The number of firms had considerably increased by the end of the 18th century, making difficult to implement the agreements of the Association. But the Napoleonic Wars boosted the prices and the demand for copper and the industry benefitted despite the more competitive environment.

At the end of the wars the demand for copper slackened and prices drastically fell. A large number of smelters withdrew from the market and a process of concentration took place. In the 1820s four firms controlled 75% of the smelter production. The two largest producers were Vivians and Co., and Foster Williams and Co.; the other two were considerably smaller, Llanelly Copper Co., and Grenfell and Sons.

After this process of concentration the decisions of the producers were so inter-dependent that no formal organisation was necessary; besides the industry had long tradition of co-operation. In such a situation the British smelters were in conditions to set the price of the ores and the prices of their output. The agreements of the oligopolists were temporary but effective: "discrepancies were not unusual but such divergencies were rarely pushed to extreme length" (1).

Important technological innovations were introduced which made it possible to recover the sulphur and other by-products such as gold, silver, and lead; the coal required to process one tone of copper was reduced (to 8 tons according to some sources of information and to 3 tons according to others). Apart from improving the quality of the metal recovered, the new technology became a considerable barrier to entry.

By the 1820s the U.K. controlled 45% of the copper mining production and 75% of the international copper trade. In this decade the smelters started to treat ores produced overseas.

In the 1830s a £6 import duty was introduced to protect the U.K. mining industry: foreign ores could be imported duty free provided the copper was exported in the form of unwrought copper.

The administration of this system was rather complicated and restricted the source of raw material of the smelters to those produced in the country, while overseas new mines were producing metals of higher copper content: but the tariff increased the incentives for co-operation among the smelters to set their prices.

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(1) A.M. John. The Industrial Development of South Wales. Page 108. University of Wales Press, 1950.

In 1843 the tariff system was modified and a duty of 1s had to be paid for all the ores imported. The new system allowed the British smelters to process most of the production of the rich Latin-American mines. The higher volume of production of raw material and the lower cost were an incentive to capture the French, Belgium and Holland markets which previously were supplied by Russia, Sweden and Turkey.

The first signs of weaknesses of the oligopoly began to appear in the 1840s: the U.K. copper mining production started to fall, the quality of the ores began to decline and the dependence of the smelters on foreign ores was increasing. However, the position of the Swansea's smelters was still strong since they controlled the technology. Moreover to improve the co-ordination of their decisions and to strengthen their position the smelters formed the Settled List of the Associated Smelters.

In the 1850s Chile became the largest copper producing country. Several confluent factors interacted to give an incentive for the Chilean miners to undermine the position of the British smelters: (i) the large volume of production could support the financing of investment in smelting facilities; (ii) the low level of price for the ores in relation to the price of the metal; (iii) by shipping the product at a higher degree of elaboration the companies could considerably reduce the cost of transport; (iv) a rich coal deposit had been developed in Chile; in addition the introduction of the steam ships had reduced the cost of transport, and coal was sold at relatively low prices in the copper mining centres.

By the end of the 1850s for the first time Chile shipped copper smelted and in the 1860s most of her production was processed in the country.

Although the U.K. copper mining production continued declining the Swansea smelters could still maintain an important, though declining, position in the world industry treating the ores of Spain and Cuba. But in the 1860s the Cornish mines were exhausted, because the metal contents of the Spanish and Cuban ores were declining, the copper miners were forced to install their own smelters close to the centres of extraction to reduce cost of transport.

For about 40 years a cartel controlled the international copper market in the 18th century; the easy access to the raw materials and the control of the copper production were the most important factors which permitted the exploitation of quasi-monopoly power. The high level of prices and profits and the discovery of new mines permitted the entry of new smelters causing the collapse of this combine.

In the 19th century an oligopoly operated in Swansea for about 40 years controlling the price of the ores and the metal. Its most important strength was the control of the technology. The decline of the U.K. copper mining production and the entry of new firms to the industry were the cause of its decline.

However, this early development of the copper industry in the U.K. and the fact that this country was the major copper consumer are two of the factors which explain why Britain has had a considerable influence on the whole history of the copper industry.

#### 4.2 Calumet and Hecla's Pools

The development of the modern technology of copper production started in the U.S. in the second half of the last century. This is the reason why the cartel organised by Calumet and Hecla is the only producers' organisation operating in a national market included in this study.

In 1845 the production of Lake Superior began, but imports continued to be the most important source of the U.S. supply, 95 per cent in 1846 and 55 per cent in 1857.

This situation changed abruptly in the next decade due to three factors:

- i) The Civil War on the one side disorganised the imports business and on the other side it boosted the demand for copper to fulfill the war requirements.
- ii) In 1861 import duties were imposed to copper.
- iii) Prices considerably increased stimulating the entry of new producers; in 1864 there were about 100 mines in production in Lake Superior, which produced about 80% of the total domestic output. Concentration of production does not seem to have been significant, so the market approached a pure competitive model.

When the conflict was over military requirements fell abruptly and prices went down from 24 to 21 cents per pound in the second half of the 1860s. Out of the 100 mines in operation in Lake Superior in 1865 only 11 remained active at the end of 1867 which is explained, on the one side by the high costs of production (about 20 cents a pound) and on the other side a substantial increase of copper imports of the low cost high-grade oxidized ores from Chile, Cuba and Peru (1).

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(1) It is possible that there were no imports from Peru. At that time there was a variety of copper which was called Peruvian in the U.S., but it was produced in Chile.



In 1867 the U.S. mining producers began to ask for a modification of the tariff which was finally granted by the Congress in 1869 (1). It is worth mentioning that during the discussion on the Bill there was a great deal of opposition from the smelters of Boston and Baltimore; this can be explained by the fact that copper from Michigan was native so it did not require smelting. The smelting business was based upon imports of ores and coarse copper (2).

In spite of the competitive conditions and declining prices prevailing in the second half of the 1860s Calumet and Hecla was organised in Michigan in 1867. Supported by financial interests from Boston, Calumet and Hecla concentrated a significant share of the Michigan and the U.S. copper market after a short period of time as can be seen in table 4.2.

Table 4.2

Share of the U.S. market controlled by Calumet & Hecla  
(in percentage of the U.S. production)

Years:	1867	1868	1869	1870	1871	1872	1873
Percentage:	6.3	20.0	44.7	50.5	56.6	58.9	68.4

In 1870 Calumet and Hecla reached an agreement with the other Michigan producers, forming the Lake Pool which controlled 80% of the U.S. production. The purpose was to exploit at their advantage the recently approved tariff.

The basis of the agreement consisted in maintaining the U.S. price by allocating quotas, controlling stocks and dumping surpluses in the international market. The possible ceiling price was given by the tariff; if the international price plus tariff were lower than the internal price, imports rose. This actually happened in 1872-74, when net imports rose reducing the domestic price from the peak of 36, early in 1873, to 22 cents per pound in 1874 (see table 4.3).

Until 1882 the copper pool succeeded in maintaining the copper price at around 20 cents per pound.

During the operation of the agreement the exports average was 15% of the U.S. production. In 1870-82 the exports of the pool were sold, on average, 3.5 cents lower than the price prevailing in the domestic market (see table 4.3). During the first years of operation of the pool the

(1) R.B. Pettengill: The U.S. Copper Industry and the Tariff. Quarterly Journal of Economics, 1931, pages 141-157.

(2) H.A. Smith: American Copper Production. 72nd Congress, 1st Session, Senate Document No.58, Government Printing Office, 1932, pages 10-11.

Table 4.3Net exports, U.S. domestic price and annual price premium

(exports: thousands metric tons; price U.S. cents per pound)

Years	US net exports	Average copper price	Annual price premium
1870	3.3	21	3.8
1871	3.8	24	5.2
1872	-2.1	26	9.4
1873	-5.4	28	7.3
1874	-5.0	22	3.7
1875	2.9	23	1.8
1876	5.7	21	2.4
1877	5.7	19	3.0
1878	5.4	17	2.9
1879	8.1	19	4.5
1880	0.6	21	6.4
1881	2.8	18	4.6
1882	1.4	19	4.2

Source: H.J. Stevens: The Copper Handbook. Press of the Mining Gazette.  
Co. Houghton.Michigan

Copper prices: Hoval A. Smith: American Copper Production. Ob.cit.

dividends of the copper companies were higher than those paid during the boom years of Civil War. But the U.S. exports of brass and bronze, as well as wrought copper declined.

In spite of the higher prices in 1870-80 there were no important changes in the structure of the copper industry. Calumet and Hecla and the other Michigan producers continued to be the most important source of supply as can be seen in Table 4.4

Table 4.4Structure of the United States Copper Production  
(in percentage)

<u>Annual Average</u>	<u>Michigan</u>	<u>Arizona</u>	<u>Montana</u>	<u>Others</u>	<u>Total</u>
1845 - 1854	76	-	-	24	100
1855 - 1864	75	-	-	25	100
1865 - 1874	85	1	-	14	100
1875 - 1879	84	4	1	11	100
1880 - 1884	60	16	16	8	100
1885 - 1890	42	12	42	4	100

Source: A. Skelton: Copper: Ob.cit.

The first signs of weaknesses of the pool appeared in the second half of the 1870s when the U.S. exports rose, reaching an average of 30% of total production; even so, the prices were lower than in the first half of the decade (see Table 4.3).

But it was in the 1880s that the copper industry experienced an important change. New mines were discovered in Montana; several factors determined that they were brought into production in the decade. Firstly, the high copper prices; secondly, the growing demand for copper due to the invention of the electrical lamp in the late 1870s; the commercialization of which required generating apparatus, distribution lines, metering equipment, etc., that is, completely new products in which copper was an essential input (1); thirdly, the establishments of railroads to the West which reduced the cost of transport to the centres of consumption located in the East.

An additional factor made easier the development of the Montana producers: the introduction of the Bessemer process of steel making into copper production permitted the exploitation of low sulfide ores, saving labour, fuel and time.

The diffusion of this new technology was relatively fast: in the 1880s 8 convertors were installed in Butte (2). Another index of the speed of the process of diffusion is the fact that by 1894 blister had replaced matte as the chief export item.

Early in the 1880s maintenance of high copper prices became increasingly difficult and harmful to the interest of the pool. When demand slackened they not only had to observe their respective share of the reduction of market demand but also to curtail production and/or accumulate stocks and/or to dump copper in the international market by an extra amount corresponding to the increase in sales made by the outsiders of the pool. When demand increased, the higher prices motivated higher production by the non-members of the pool, making the disposal of the inventories more difficult without causing a considerable price reduction. Obviously the leading member of the pool, Calumet and Hecla, had to assume the burden of this responsibility, continuously increasing its financial commitment.

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(1) The first power station served the Wall Street district of New York in 1882 (R. Sultan. Pricing in the Electrical Oligopoly).

(2) E.S. May: Copper Industry in the United States.

The members of the pool failed to co-ordinate their decisions with the outsiders of the cartel and all the producers were compelled to accept much lower prices which gradually fell from 19 cents in 1882, to 16.5; 13.0; 10.8 cents in each of the years 1883-85. Finally, in 1886 Calumet and Hecla reduced its price to 10 cents to introduce producers' discipline among the West miners. The most important producers of Montana shut down.

The market position of the members of the pool experienced a drastic reduction from 80 per cent in 1875-79 to 60 per cent in 1880-84, and to 43 per cent in 1885; they could increase their share to 51 per cent in 1886 but when the Montana producers re-started production in 1887 the Michigan's share fell to 42%. The Michigan companies had to hand-over the lead of the copper industry to the Montana producers. The price policy of the pool had accelerated this process.

However, the pool was successful in the 1870s: it stabilized the prices at a relatively high level and the members obtained high level of profits (1). In the 1880s its operation became the typical case in which unco-operative outsiders enjoyed the benefits of cartelization without sharing the obligations of the members of the cartel.

It is difficult to define what would have happened if the pool had not been organised. It is likely however that the prices of copper would have been lower in the 1870s due to the more competitive environment; but possibly the prices would have been higher in 1881-1885 since the Montana producers would have expanded at the lower rate of growth.

#### 4.3 The Secretan Corner

The U.S., Spain and Chile supplied 79% of the world copper output in 1886. In spite of the growing demand of the electrical industry prices were falling; in December the Chilean Bars were quoted at about £38 a ton in the London Metal Exchange. This situation was the result of the high rate of growth of the U.S. copper production and the lack of co-ordination among the leading producers (2).

In 1887 the Secretan Syndicate was organised. Hyacinth Secretan was the Director of the Societe Industrielle et Commerciale des Meteaux, the largest French copper semi manufacturing concern and the biggest buyer of

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(1) H.A. Smith: American Cooper Production. Ob.cit., pages 25-26.

(2) At the end of 1886 and early in 1887 there were contacts between Spanish and U.S. producers. The negotiations were interrupted when they knew about the offer and proposal of Secretan.

ingot copper in the world. The pool had the active support of the most important financial organisations the Comptoir d'Escompte, the Banque de Paris et Pay Bas, the Paris Rothschild and the Bearing Bros. This organisation provided initial 2.8 million pounds in advance and credit to finance the operation (1).

The Syndicate bought shares of Tharsis and Rio Tinto, the Spanish suppliers, and it also started negotiations to buy other concerns in the United States (2). It also contracted the production of the 38 most important producers for the next three years, which represented 80 or 85 per cent of the world copper output (3). The contracted average buying price was around £65 a ton. The contract established a clause which made the producers limit production and it had the guarantee of the Comptoir D'Escompte, the second bank in France.

By the middle of 1888 copper prices had risen to £80 a ton and to £112 in September. The profits of the Societe Industrielle et Commerciale had risen to 78% of its capital and the prices of its shares were several times those prevailing before the organisation of the pool. Rio Tinto and Tharsis paid a dividend of 20 per cent (4).

On the other hand, stocks of copper increased to about 70,000 tons in mid 1888. Consumption declined and consumers postponed the purchases of copper. Production increased by 20% while supply of scrap was also rising. The Syndicate was forced to buy the increasing amounts of copper from new sources of supply.

Up to that time the London Metal Exchange based the quotation on Chilean Bars; this fact made the control of the price easier for the syndicate, because that country was the marginal supplier and buying the available Chilean supply had an important impact on the prices. In 1888, the London Metal Exchange altered the basis of the contract in order to deal also with other brands (4). This change made the task of the syndicate more difficult.

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- (1) J.S. Jeans: *Trusts, Pools and Corners*. Chapter X: The Copper Trust, pages 112-117. Methuen & Co., 1894.
- (2) D. Avery: *Not on Queen Victoria's Birthday: The Story of the Rio Tinto Mines*. Collins, 1974.
- (3) E.B. Andrews: *The Late Copper Syndicate*. *Quarterly Journal of Economics*, Vol.111, July 1889, page 510.
- (4) D. Avery: *Ob.cit.*, page 378.

Early in 1889 the stocks held by Secretan had increased to the equivalent of nine months consumption and the company had already borrowed 6.8 million pounds, 50 per cent on a short term basis. Negotiations in order to establish lower producers quotas failed. In April the Societe des Metaux refused to take delivery of its monthly supply. Comptoir D'Escompte which had invested most of its resources in the copper trade, announced it would go into liquidation. The price of copper fell to 35 pound per ton.

Mine producers of the United States and British Banks took control of the copper stocks. Spanish producers agreed to reduce production by 10% according to the U.S. producers version and by 7½% in accordance with Spanish sources. The U.S. producers accepted to reduce their shipments to Europe to 60,000 tons which was not adhered to according to the version of the Spanish suppliers. Another source of conflict between the financial organisations and copper producers was the stock disposal policy. Nevertheless the price was maintained between 40 and 50 pounds a ton during the next two years.

#### 4.4 Amalgamated's pools

Before making any reference to two other attempts of controlling copper prices before World War I some important facts in the development of the copper have to be dealt with.

In 1892 Anaconda set up the first electrolytic refinery, becoming the first company vertically integrated from mining to refinery. The new process had multiple implications.

Firstly, it permitted the making of purer copper and gave a homogeneity to the product which had never been obtained before in substantial quantities. This represented an impulse to the growing electrical industry. Until the 1930s it gave an absolute monopoly to the copper in the electrical field.

Secondly, precious metals could be recovered as a by product, reducing the cost of production.

Thirdly, it definitely shifted the technical control of the industry to the U.S.

In the leading producing area of the U.S. (Butte, Montana) three new processes of production were introduced in less than a decade: block-caving, bessemering, and electrolytic refining. These developments had a significant repercussion on Butte where the mining concessions were held by a large number of small companies. The new processes increased the amount of capital per unit of copper and enlarged the economic scale of production. The new technology was determining a process of industrial concentration which was also influenced by another two factors: (a) the Appex Law granted

the owners of a mine the right to follow the vein which was exploiting even when it continued under the surface of a different claim. The most organised companies accumulated titles of ownership in the interrelated geological structure of Butte; (b) But the decisive impulse to the process of concentration was given by the organisation of Amalgamated Copper Company in 1889 (1). This was a holding company where the interests of Standard Oil, the National City Bank and the most important nucleus of production of Butte were represented (2).

In 1901-03 Amalgamated controlled about 20% of the U.S. production (3) but the United Metals company sold 50% of the total output of the U.S., that is, about a fifth of world output (4). This company was the selling agent

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(1) One of the best descriptions of the operation of this holding can be found in F.E. Richter: *The Amalgamated Copper Company: A Closed Chapter in Corporation Finance*. *Quarterly Journal of Economics*, February 1916, pages 387-407.

(2) When Amalgamated was organised it consolidated under one administrative control an important part of the copper companies of Butte; this permitted rationalization of the processes of production of the deposits since the very beginning. For example, it controlled a smelter and a refinery which serviced all the members of Amalgamated.

In 1907 Amalgamated controlled all the important copper deposits of the area except the ones owned by Senator Clark. Moreover, it also controlled companies supplying timber, coal, a rail-road and an electric company which serviced the mines of Butte.

In 1915 Amalgamated was dissolved and the assets were transferred to Anaconda. This company combined copper concerns in Montana, Utah, Arizona, New Jersey and Mexico; it was vertically integrated from mining to selling. The causes of the dissolution of such a successful holding were: the order to dissolution given by the Tribunals to Standard Oil in 1911; the federal corporation income tax which under a holding company regime resulted in double taxation of profits; and probably the conflict in the Tribunals with Heinze (owner of some veins of Butte which were bought by Amalgamated, the conflict was going to last until the 1930s).

(3) A. Skelton: *Ob.cit.* page 304. However J. Moody states that Amalgamated controlled about 30% of the U.S. output (*The Truth About the Trusts*. Moody Publishing Co., 1904, page 4), which coincides with the 33% given by F.E. Richter (*The Copper Mining Industry in the U.S., 1845-1925*. *Quarterly Journal of Economics*, Vol.41, 1926-27, page 251). Finally, one publication of the U.S. Dept. of Commerce and Labour, Bureau of Census estimates the share of Amalgamated in 43% of the U.S. output (*Mines and Quarries*, 1902, page 489).

(4) F.E. Richter: *The Amalgamated Copper Company*. *Ob.cit.* It is noted that Richter warns that the figure is a rough estimate.

not only of the mining companies controlled by Amalgamated but also of other concerns; it was not a member of the holding company but it was owned by the same interests which controlled Amalgamated.

At that time copper could be imported free of duty in the U.S. (1). This country produced about 55% of the world copper output and 36% of its production was exported; moreover, this was the only country which had electrolytic refineries.

In 1899, Amalgamated, supported by the Michigan producers, reduced output. The price of copper rose from 11 to 17 cents per pound where it stayed until the end of 1901. However, in 1898-1901 the producers outside the U.S. increased output by 30% while in the U.S. the outsiders of the pool augmented production by 15%, forcing the members of the pool to make further cuts. Moreover, in 1901 a recession affected Europe and the U.S. copper exports fell by 40%; the stocks of Amalgamated rose up to 136,000 or 181,000 tons (2).

By the end of 1901 Amalgamated had negotiations with the major suppliers outside the pool but no agreement was reached. Amalgamated ran into financial difficulties and could not continue supporting the price of copper which dropped to 11 cents early in 1902.

London Branders, Goldschmith and Co., gave financial support to Amalgamated and the excess of stocks could be liquidated in the next three years. The recovery of the demand for copper outside the U.S. and the high rate of growth of consumption in the U.S. made it easier to overcome the market dessequilibrium (3).

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- (1) Act of August 27, 1894 in H.A. Smith: American Copper Production, 72nd Congress, 1st Session, Senate Document No.58. Government Printing Office, 1932.
  - (2) A. Skelton: Ob.cit., page 305. But in the report of the U.S. Federal Trade Commission a figure of 272,000 tons is given.
  - (3) C.L. Knight states that Amalgamated supported the prices of copper during an eventual recession in Europe in 1904-1905, but he does not specify the policies implemented by Amalgamated (Secular and Cyclical Movements in the Production and Prices of Copper. Philadelphia: University of Pennsylvania Press, 1935, page 129). Herfindahl (Ob.cit., page 84) argues that the prices did not fall because there was not a decline in demand; however he does not make any reference to the stock policy disposal implemented by Amalgamated in 1903-1905. Without such a policy the prices would have been lower.



In 1906 Amalgamated, again with the support of the Michigan producers, decided to make another price increase. Amalgamated had just consolidated its position in Butte, having bought the mines of Heinze, its most tenacious competitor.

Production was reduced at Butte and maintained in Michigan in 1906 and 1907. Prices began to rise, reaching a level of 25 cents per pound in 1907, but they fell to nearly 12 cents the same year of the peak.

Table 4.5 illustrates the process which took place. Production of the two participating areas was reduced by 2.5 and 15.2 per cent in 1906 and 1907 respectively. If the production of the non participating areas is considered altogether, it increased by 12 and almost 8 per cent in 1906 and, 1907 respectively. The amounts reduced by Montana in that period was almost compensated for Arizona and others which obtained a net gain market share.

Table 4.5

United States production by States  
(in thousands tons and percentage)

Year	Michigan		Montana		Arizona		Others		Total	
	Quant- ity	% of Total	Quant- ity	% of Total	Quant- ity	% of Total	Quant- ity	% of Total	Quant- ity	% of Total
1905	102	25	141	35	104	26	56	14	403	100
1906	104	25	133	32	121	29	58	14	416	100
1907	109	25	102	26	118	30	75	19	394	100

Sources: Production based on H.A. Smith. American Copper Production.  
Distribution by States: J. Stevens: Copper Handbook, 1917.

At the same time that Amalgamated was trying to raise the price of copper it started the development of the porphyry deposits. This technological innovation is not directly related to the price policy of the pool, but it is likely that the higher prices had encouraged the investors and organisations which financed the investment.

The new development increased the importance of other companies and shifted the centres of production to other geographical areas in the United States. Thus Amalgamated, later Anaconda, and Michigan producers were not going to be anymore able to define the price policy of the copper industry by themselves.

In 1909 the Association of Copper Producers was formed. It included all the major U.S. producers.

From its creation until World War I there were persistent rumours of price manipulation. However, there is no evidence that the Association had an active role in the co-ordination of the producers. However, it improved the statistical information and possibly the mechanism of communications among the suppliers, hence making easier the co-ordination of their decisions

As a matter of fact the European copper consumption experienced an important increase in 1912; prices rose from 13 to a peak of 18 cents and were stabilized between 15 and 16 cents for most of 1912-13.

It is noted that the Association was formed when the two largest suppliers were making substantial financial commitment. Phelps Dodge, the largest producer in Arizona, was acquiring mineral concessions and copper mines; the shareholders of Anaconda authorized an increase of Anaconda's capital from 30 to 100 million dollars, part of which was to be used in the acquisition of new companies. In such conditions both were interested in avoiding intense competition.

The war started in 1914. The analysis of the evolution of the industry in this period is not in the scope of this study.

#### 4.5 The Development of the Porphyry Deposits

In porphyry copper deposits the minerals are rather uniformly scattered through the rock, usually in a large area. The grade is relatively low. In order to bring these deposits into production it is necessary to concentrate the mineral before smelting. This process was first performed by gravity, but later flotation was introduced (1910) (1).

To give an idea of the speed of diffusion of the new method of production table 4.6 presents the most important porphyry deposits developed in the first quarter of this century, defining the date when they were brought on stream.

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(1) R. Prain states that the first copper mine of any size and importance to use the flotation process was El Teniente, controlled by the Guggenheim. (Copper: The Anatomy of an Industry, Ob.cit., page 25).

Table 4.6Development of the Porphyry Deposits

Deposit	Date it came into Production	Company	Absorbed or Controlled by
- Utah Copper Company	1907	Daniel C. Guggenheim	Kennecott
- Morenci Mines (Detroit Copper Company, Arizona Copper Company and Clay Mines, Arizona.	1907	Phelps Dodge	
- Ray Consolidated Copper, Arizona.	1908	Guggenheim	Kennecott
- Chino Mine, New Mexico.	1910	Guggenheim	Kennecott
- Miami Mine, Arizona	1911	Lewisohn Family	
- Inspiration Consolidated	1915	Anaconda	
- Calumet and Arizona Mining Company.	1917	Calumet & Arizona	Phelps Dodge
- Copper Queen	1923	Phelps Dodge	

Source: Based on E.S. May Copper Industry in the U.S., in International Control in the Non-Ferrous Industry.

According to a general principle the larger the benefit obtainable from a technological innovation the faster its diffusion will tend to be; this principle also applies to this case. Table 4.7 is a cross-section of the cost of production in use in the United States in the last years of the second decade of this century. It shows that the only method whose cost per unit continued to fall at the highest level of production is in the porphyry deposits. In the case of the Michigan producers the per unit cost started to rise when production increased beyond 5,000 short tons. In the other group, they rose when costs were higher than 35,700 short tons.

The development of the porphyry deposits implied an enlargement of the scale of production and of capital requirements in mining and milling. An intense use of loading and haulage units was required in the mining and larger equipment for hauling and grinding was needed for milling.

Table 4.7Cost of copper production by type of deposit and quantity produced in 1918

Type of ores Michigan	Number of Deposits	% of Production	Cost per pound (in cents)
Up to 1000	5	3.1	0.37
1000 - 2500	6	8.7	0.23
2500 - 5000	4	14.9	0.16
more than 5000	6	73.3	0.17
Non Michigan and non porphyry deposits			
Up to 500	5	0.3	0.28
500 - 2500	15	2.9	0.27
2500 - 5000	13	7.8	0.21
5000 - 12,500	7	9.5	0.21
12,500 - 25,000	4	13.0	0.19
25,000 - 35,000	5	23.7	0.13
more than 35,700	4	42.8	0.16
Porphyry			
7,500 - 25,000	4	12.2	0.18
25,000 - 49,000	4	37.8	0.16
more than 79,000	3	50.0	0.14

Source: Cost Report, Federal Trade Commission, June 30, 1919.

The development of the porphyry was supported by financial organisations: Guggenheim was connected with Morgan; Anaconda with Rockefeller; Phelps Dodge's capital derived from the metal trade of New York. This situation explains the rapid process of concentration that took place in the copper industry in this period.

Although the process of concentration of production was going to continue until the 1930s, the structure of the United States copper industry was defined in 1910. Threemine producers (Kennecott, Anaconda, Phelps Dodge), and principally two custom smelters (American Smelting and Refining Company and American Metals), were the centre poles. Their structure will be outlined here briefly.

Anaconda was already a vertically integrated corporation from mining to selling agency. In 1922, it bought the American Brass Company, thus, entering the manufacturing stage. As the production capacity of the mill was greater than the possibilities of supply of copper, it bought the Chile Copper Company which had been developed by Guggenheim, and part of the interests of the deposits of Andes Copper Mining, brought on stream in 1927. It also acquired the Detroit Copper Company in 1927, and finally the Anaconda Wire and Cable Company in 1929. Anaconda was the first fully integrated copper company (1).

The early history of Kennecott was closely associated with Guggenheim and through him with Morgans. Kennecott Copper Corporation controlled an important number of deposits in Alaska. Most of the porphyry deposits were developed with financial support from the Guggenheims passed to the control by this Corporation, among them the Braden Copper Company in Chile. Until the 1940s most of the copper produced by Kennecott was smelted and refined by the American Smelting and Refining Company, due to the connection of the latter with the Guggenheim this company entered into the fabricating stage when it purchased the Chase Company in 1929.

Phelps Dodge had its camp of operation in Arizona, whose importance was growing. This company increased its importance with the development of the porphyry deposits. In 1928 it purchased one of the important custom smelters, the Nichols Copper Company, becoming the second biggest concern which fully treated its copper. In 1930, it acquired the National Electric Products Corporation. Finally in 1931 Phelps Dodge absorbed Calumet and Arizona, the last of the remaining independent companies in the Besbet District.

The American Smelting and Refining Company ASARCO was originally a lead smelter concern. It was associated with the Guggenheims when it absorbed their interest in the lead mining industry. This company entered into the copper industry when it built the copper smelter to treat the ores of the Utah Copper Company, the first porphyry deposits brought into production. ASARCO developed the larger smelting and refining facilities of the United States, an important part of which was used to treat the ores of Kennecott. In 1928, ASARCO bought the General Cable Corporation, a semi-fabricating concern. One year later it purchased the Federated Metals and with it ASARCO entered into the secondary copper industry (2).

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- (1) For a historical account about the evolution of this company see I.F. Marcossou. Anaconda. Dool, Mead , 1957.
  - (2) For detailed accounts about the evolution of ASARCO see: I.F. Marcossou: Metals Magic; the Story of the American Smelting and Refining Company. Forres Strauss. 1949 and I.F. Morcosson: Copper Heritage; The Story of Revere Copper and Brass Incorporated. Dool, Mead, New York 1955.

Finally, the American Metal Company was the second largest custom smelter. It was originally formed with German, United States and British capitals. After the First World War the German interests were sold following governmental orders. Early in the 1920s the British Company which owned the shares of the American Metal Company had to be dissolved. But the financial connection remained, for this was the only United States copper company allowed to enter Northern Rhodesia to exploit the rich copper deposits of that area.

It should be noted that early in this century the United States corporations controlled a new technology of copper production ranging from the mine to the refinery. As a country it controlled 55% of world copper production and its copper companies had investments in Chile, Mexico, Peru, Cuba and Canada. The United States produced almost the total world output of electrolytically refined copper. This prominence in technology and production is one of the facts that explain the predominance of the copper producers of this country in the international copper trade for the next half century and why that country still continues to be the leading copper producer.

#### 4.6 The Copper Exporters Association

During the First World War copper production rose by 43%. An important part of the increase was used in arms and ammunition industries.

A significant part of the copper produced outside the U.S. was imported by this country refined and sold to the Allies either as refined copper or semi-manufactured products or bullets.

Outside the U.S. the evolution of copper production can be summarised as follows: in Spain production was affected by labour action; in Russia it was affected first by the war and later by the revolution; other European countries were marginal producers: in Australia, the high grade deposits had almost been depleted and production declined; Japan was the only Asiatic producer: before the war it was a net exporter but it became a net importer in spite of the increase in production due to the substantial growth of consumption (1). South Africa and Rhodesia were marginal producers, but in the Belgian Congo, a corporation succeeded in bringing into production the rich deposits of Katanga. In Chile, mass production

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(1) D.C. Morison: The Recent History of the Copper Trade. Economics, Vol. 4, 1924, pages 353-368.

Table 4.8

Copper Production and Primary Consumption 1913-1923 (thousand tons)

## a) Production

Years	U.S.	Mexico	Canada	Chile	Peru	Congo	Japan	Others	World
1913	561	53	34	43	28	5	66	213	1003
1914	521	36	34	44	28	10	71	187	931
1915	675	31	45	53	44	14	75	192	1129
1916	910	55	54	72	43	22	101	186	1443
1917	860	47	50	102	45	27	108	211	1450
1918	766	75	54	115	44	21	91	151	1417
1919	550	61	34	80	39	23	79	148	1014
1920	556	51	37	99	33	19	68	117	930
1921	211	13	22	59	34	31	55	116	541
1922	437	27	19	130	36	44	55	114	862
1923	670	54	39	182	44	56	59	146	1250

## b) Consumption

Years	U.S.	Great Britain	Germany	France	Italy	Others	World
1913	329	141	259	102	41	183	1055
1914	267	169	190	86	41	149	902
1915	504	200	73	110	68	185	1140
1916	713	181	54	152	86	219	1405
1917	601	227	50	188	59	230	1355
1918	631	218	50	148	9	236	1292
1919	516	91	45	55	5	239	951
1920	449	93	81	68	5	210	906
1921	275	68	127	49	6	164	689
1922	412	45	148	83	7	223	918
1923	532	102	97	115	9	252	1107

Source: Year Book of American Bureau of Metal Statistics.

had started in El Teniente and later in Chuquicamata, both deposits were exploited by U.S. corporations. In Mexico, in spite of the Mexican Revolution, production increased by 43 per cent; 90% of the total output was controlled by U.S. interests (Anaconda and Phelps Dodge).

In 1918, the U.S. produced 61% of world output and, through the subsidiaries controlled by U.S. corporations, 78.0% of the total. The concentration in terms of companies was also high, the most important U.S., producers controlled 63.4% of the output of their country, (that is, 38.8% of world output) and through their subsidiaries in other countries about 43% of world output. It is likely that concentration was higher at the smelter and refinery stages, but there is no reliable information to prove it. Nevertheless, Richter gives figures of sales in 1916 classified by selling agents which tend to confirm the higher concentration in the last operation of the process of production.

<u>Selling Agent</u>	<u>Tons</u>	<u>Percentage</u>
American Smelting & Refining	474.4	40.2
United Metals Selling Co.	270.8	22.9
Phelps Dodge & Co.	112.0	9.5
American Metal Co.	76.6	6.5
Calumet and Hecla	72.6	6.1
L. Volgelstein & Co.	72.6	6.1
A. Lewisohn & Sons	32.7	2.8
Beer, Sondheimes & Co.	13.6	1.1
Direct sales by 5 mining companies	36.2	4.8
TOTAL	1181.5	100

Source: F.E. Richter: The Organisation of the Copper Market. Harvard Business School, January 1923, pages 196-211. Page 200.

The first impact of the war was a drop in prices. The main producers cut production to about 70% of their capacity. This situation is mainly explained by two factors: Germany and its Allies absorbed more than 50% of the U.S. exports, and it was not allowed to sell to those countries. Second, during the first year of the conflict production and trade was disorganised in France, Russia and other continental countries. In 1915, production and prices began to increase. From February 1916 prices fluctuated between 25 and 32 cents per pound, but in September 1917, the price was fixed at 23½ cents per pound by a presidential order. In June 1918 it was raised to 26 cents. It is noted that the last price fixed by the government was even higher than the peak obtained by the Amalgamated in the 1900s; governmental sources justified it by stating that the aim of the policy was to stimulate production of high cost mines.



When the conflict was over, demand had fallen below its pre war levels: the reduction was more drastic in Europe than in the U.S. On the supply side significant changes had taken place, the U.S. production was mainly supplying the internal market, its net exports were about 15% of its production against 36% before the war. New sources of supply had been developed to meet the European demand, in Chile and the Belgium Congo which had lower cost.

There were considerable variations in the level and structure of cost (1). But about 67% of the copper was produced by large mines, while the smallest reported the highest cost.

Table 4.9

Cost of production in 1918

(cost in cents per pound, production in thousands tons)

Cost	Production	Percentage	Accumulate Percentage
less than 12	55	5.3	5.3
12 - 13	95	9.3	14.6
13 - 14	143	14.0	28.6
14 - 15	163	15.9	44.5
15 - 16	44	4.3	48.8
16 - 17	209	20.4	69.2
17 - 18	116	11.3	80.5
18 - 19	33	3.2	83.7
19 - 20	13	1.3	85.0
20 - 21	17	1.7	86.7
21 - 22	62	6.0	92.7
22 - 23	28	2.7	95.4
23 - 24	20	2.0	97.4
24 - 25	3	0.3	97.7
25 - 26	3	0.3	98.0
Over 26	21	2.0	100.0
TOTAL	1025	100	100.0

(a) The cost are based on 85 mines which covered the production of 95% of the U.S.; 94% of Chile; 71% of Peru; 58% of Mexico; 50% of Canada and 20% of Cuba.

Source: D.C. Morison: The Recent History of the Copper Trade Economics 1924, Vol.9, page 354.

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- (1) The War Industry Board reported that in 1918 there was the following structure of cost:
- mine production 39% (variation from 29 to 62 per cent of the total)
  - smelting 31% (variation from 25 to 55 per cent of the total)
  - refining 6% (variation from 0.6 to 7 per cent of the total)
  - Others (sales and general expenses) 25% (if it is not specified the variation)

Table 4.9 reveals two problems which producers faced: the high level of cost and the large fringe attracted to the market by the high prices.

Two other problems confronting the producers were the excess of productive capacity and the surplus of copper stocks. The first one, the capacity of production, had increased by about 65% during the war most of the new capacity having been set up to supply war requirements; the demand for arms and ammunitions diminished considerably after the Armistice. It was necessary to adapt the copper supply to the peace conditions and this required time.

As for the surplus of copper stocks there is no reliable information. C.D. Kelly, President of Anaconda, gave the following estimates 22 years later (1):

Crude, process and refined copper	380,000
Government copper (United States and United Kingdom)	285,700
In scrap and brass	366,400
TOTAL	932,100

These figures are not entirely compatible with the estimates of Skelton of 217,700 of virgin copper (2), and 363,000 tons of scrap and brass held by European governments, plus 900,000 tons of recoverable scrap which lay in the battle fields of the Western front. Mrs May (3) calculated the stocks in the U.S. at the beginning of 1919 as 317,718 tons of virgin copper and the stocks of scrap as twice that amount.

Other sources of information give figures which are not entirely comparable with those already quoted, but there is general agreement that stocks were high (4).

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- (1) Temporary National Economic Committee (TNEC) Hearings, Part 25, Exhibit 2116.
  - (2) If 58,900 tons of virgin copper are added which were held by the government of the United States, it would come to a total of 276,000 tons, which is lower than the figure of Mr. Kelly for the U.S. and U.K. government.
  - (3) E.S. May: The Copper Industry in the U.S. Ob.cit.
  - (4) For instance D.C. Morrinson. Ob.cit.

In the United States cartels were illegal under the Sherman Act of 1890. But on April 10, 1918 the Webb Pomerene Act was passed which authorized the U.S. sellers to form associations for the sole purpose of engaging in export trade.

One month after the Armistice the Copper Export Association was formed by the leading copper producers. The objective of the organisation was "to enable the holders of the association's stocks without par value to co-operate with one another solely in export trade in accordance with the Webb Act" (1). The same objective is emphasized in the letter sent to the producers inviting them to join the organisation, which says that prior to the war the United States copper producers "were compelled in their export trade to compete with one another in selling copper to foreign buyers who were united in buying combinations". So the objectives of the organisation were not only related to the disposal of stocks accumulated during the war as was persistently stated in the T N E C hearings or in the analysis done by I.F. Marcossou (2).

It is also noted that the members of the Association insisted that their activities were only orientated to the foreign market but it is almost impossible to separate the effects of the Association's policies on the national and international market. In both markets the price policy was the same; the cuts in production were made not only in the U.S. but also in the subsidiaries of the members of the cartel.

The Association acted as a selling agent for the members (3). The copper was furnished to the Association according to quotas assigned to the members. In order to handle the operations in the U.K. (4), the Association set up a sale agency in London.

One of the characteristics of the organisation was that the right to vote was accorded only to part of the shareholders (the tenants of non-par value shares) but each share entitled the owner to one vote for each 500 short tons of copper produced, as estimated by the Board of Directors for the last 12 months (5). On the Board of Directors were representatives

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- (1) The Bill had actively been promoted by the government. Some agencies reports cited the copper industry as an example for the need of such legislation. This indicates the support given to the cartel of the copper producer by the government.
- (2) I.F. Marcossou: Anaconda, Ob.cit.
- (3) Non-members also sold through the Association but it was not possible to define if they did so throughout the active period of the organisation.
- (4) I.F. Marcossou: Ob.cit.
- (5) Report of the Federal Trade Commission Ob.cit., pages 204-205.

of the larger producers and one of the selling agents, L. Vogelstein and Co.

In 1919 the Association controlled 88% of the U.S. production, that is 50.3% of world output; but if the member subsidiaries are included, this organisation controlled 65.4% of the world production.

According to the statement of Mr Kelly (President of Anaconda) in the TNEC hearing in 1940, the export prices set by the Association were based on domestic prices. In fact, the prices of the Engineering and Mining Journal E & M J, were almost the same as the prices fixed by the Copper Export Association (CEA) for the whole period for which information about the prices of the latter is available (1).

The first post-war price published by the E & M J was 16.8 cents per pound in February 1919; it fell to 15.2 in March and started to rise until it reached 22.3 in August; it dropped again but it remained stable between 18 and 19 cents until September 1920 when it fell again and afterwards fluctuated between 11 and 14 cents from January 1921 till November 1922. After a new rising trend nearly in 1923 the prices dropped and fluctuated between 12 and 13 cents in the last month of that year.

In 1919 production was curtailed by 43% by the U.S. members of the Association and by 33% in their subsidiaries in other countries. The non-members of the CEA reduced production by an average of 18% but in Spain it was increased to 250% and in the Belgian Congo by 17 per cent. It is likely that the price reduction in 1919 had eliminated the high cost producers in the competitive fringe.

Table 4.10

World Copper Production according to affiliation and non affiliation to the Copper Export Association (CEA) (in thousands tons)

Years	World		Members of CEA and their foreign subsidiaries		US and other non-members of CEA	
	Quantity	% Variation	Quantity	% Variation	Quantity	% Variation
1919	971	-	635	-	336	-
1920	982	1.1	663	4.4	319	-5.1
1921	546	44.1	206	-68.9	340	6.6
1922	903	+65.4	511	148.0	392	15.2
1923	1280	41.7	792	55.0	489	24.7

Source: Based on Report of the Federal Trade Commission  
Ob.cit. Table 34, page 203.

(1) The E & M J prices were always lower (except in two months) than the prices of the CEA. The difference between them fluctuated between 0.2 and 0.8 cents per pound.

In 1920, copper consumption continued falling and an additional problem was imposed on the copper suppliers: the New York Federal Reserve Bank decided that "it would not renew discounted drafts collateralized with copper as tangible at the end of their maturity, except for one half the amount" (1). Such a decision increased the financial pressures on the stock holders in general and on the primary producers in particular. The impact on price was to be significant if not counter measure was adopted.

By the end of 1920 the first post-war economic recession began, in 1921 consumption was to be equivalent to 50% the demand of 1918. By October prices began to fall from 18 cents per pound to the level at which they were to fluctuate during most of the period 1921-24: 11-13 cents.

Drastic decisions were adopted by the Association:

Early in 1921 the Association decided to buy 200,000 tons of refined copper held in stocks by the U.S. producers. The operation was financed by a group of bankers of New York to whom the Association sold 40 million dollars of gold notes at 7 per cent at five years.

The companies sold the copper to the Association at 10 cents per pound but agreeing that if the price of resale was higher, the net difference would be paid to the producers. The stock was formed in March 1921.

In January 1921 the members of the Association reduced wages and salaries by 15%.

In May 1921 the most important U.S. producers shut down and remained closed until February 1922.

In September 1921 the market showed the first symptoms of recovery. for the first time the Association sold a small part of the stocks.

In 1922, the world economic situation began to improve. The U.S. producers restarted their operations, but using no more than 60% of their capacity: world consumption over passed production permitting the continuation of the disposals of inventories held by the Association; prices began to increase by the end of the year.

In 1923, the situation continued improving: the stocks of the CEA were completely sold in September, but production increased more than consumption affecting unfavourably the prices.

Early in 1924, the Guggenheim and Phelps Dodge withdrew from the CEA. The organisation continued to exist until the 1930s, but as an organism of oligopolistic co-ordination it became inactive in February 1924.

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(1) I.F. Marcossou: Anaconda, Ob.cit.

The reason for the dissolution of the CEA is open to various interpretations. Here it is postulated that the Association showed a basic weakness when it only included U.S. companies. Although neither the Spanish nor the Congolese producers controlled an important share of the market, the former augmented its output when the U.S. made the greatest cuts; the latter increased production by about 350% between 1918-1924, and part of this additional production was reaching New York (1), furthermore the Belgian Company was investing so it was to become more important in the near future.

The fact that the two first producers which withdrew from CEA were companies without subsidiaries in other countries gives relevance to another reason. Except in 1921, Kennecott increased the production of its Chilean subsidiary Braden Copper Company and Anaconda augmented output in Greene Cananea in Mexico and Chile Copper Company in Chile; the production increase in their Chilean subsidiaries almost doubled the 1918 Chilean output and the share of Chile in world production increased from 9 per cent in 1918 to 15 per cent in 1924. The lower cost of production of this source of production compensated at least in part the losses that these companies had experienced in the U.S. But what may have been unacceptable to Guggenheim and Phelps Dodge was the fact that their output cuts were making easier the expansion of the subsidiaries of their rivals.

The decisions of the U.S. producers were inter-dependent with those suppliers located in other areas which were competing mainly for the depressed European market. The intense competition had direct influence on the prices of the U.S. suppliers. To reduce this impact co-ordination was necessary but CEA lacked any mechanism to co-ordinate producers' decisions on a world basis; moreover the U.S. companies had doubts, whether it was legal to create a cartel with non-national members as will be demonstrated in the analysis of the second international cartel of the inter-war period.

However, by 1924 the objectives of the Copper Exporter Association had been accomplished. Firstly, the stocks held by American producers had been reduced from 71% to 12% of their production, and the stocks held by consumers also had been absorbed by the market. Secondly, it is likely that an important part of the higher cost producers had withdrawn from the market. Thirdly, if it is assumed that in 1923 capacity of production was equal to the peak production of the war it would mean that producers were using more than 80% of their capacity. Fourthly, a price war was avoided. Fifthly, the prices were maintained above the pre-war levels, but below these of 1915-1920.

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(1) F.E. Richter: The Organisation of the Copper Market. Harvard Business School, January, 1923, page 203.

As a by product of the co-operative efforts in the copper market other two actions were important: in the first place, the copper producers and a group of fabricators created the Copper and Brass Research Association which began research into possible new uses of copper, diffusion of the characteristics of the metal and a great deal of promotional work among the final users. In the second place, the copper producers joint efforts with the tin and zinc industry and created the American Bureau of Metal Statistic whose main function was to compile and to publish statistics about these metals, which were the most complete at that time. These two developments tend to confirm the general assessment that the co-operative efforts of producers improve statistics and promotional activities in an industry.

The cost of the U.S. producers' policy was significant: reduction of wages and salaries, the shut down of the largest mines for 10 months and the consequent un-employment. It is not possible to determine the alternative cost of the other possible strategic option of the producers: unco-ordinated action: but it can be said that its cost would also have been very important and possibly the market disequilibrium caused by such a policy would have lasted for a longer period.

Despite the improvement in the market conditions in 1923-24 equilibrium was not reached, there was still idle capacity and new investment was to reach the stage of production. A new mechanism of co-ordination was necessary but it had to include the copper companies controlled by the European and the subsidiaries of U.S. companies in Latin America.

#### 4.7 Copper Exporter Inc.

The second inter-war copper cartel was organised in 1926. Prior to its formation the conditions of the copper industry had been improving. Both production and consumption had been growing and were closely balanced, so copper inventories held by producers were even lower than those of the late 1923 in relative terms. In 1925 consumption was higher than the peak of 1,405 thousand tons of 1916, and at that same time the ambitious electrification plans of the European countries were already known. Prices were 7 or 8 cents lower than the average of 22 cents during the five years of war; but those levels had permitted an average dividend of 3.5 cents per pound of production to the U.S. companies.

Table 4.11World mine production world primary consumption and average electrolytic price in New York

(Quantity in thousands of tons - Price cents of U.S. dollar per pound)

Years	Production		Consumption		Prices
	Quantity	% Variation	Quantity	% Variation	
1923	1,250		1,107		14.3
1924	1,327	6.2	1,326	19.8	13.0
1925	1,407	6.0	1,414	6.6	14.0
1926	1,468	4.3	1,475	4.3	13.8

Source: Based on Skelton: Tables on the Copper Industry.

Some investment projects were in development. The most important were the investments of the Andes Copper Company, subsidiary of Anaconda, in Potrerillos, where the project envisaged a capacity of 90,000 tons; another subsidiary of Anaconda the Chile Copper Company was constructing new reduction plants: the Union Miniere de Haut Katanga continued investing to obtain a total capacity of production of nearly 150,000 tons (1). There were also investment projects in Eastern Canada, where copper could be obtained as a by-product of nickel at low cost.

These developments were gradually changing the character of competition in the copper industry. More than 50% of the world output was produced in the U.S. and U.S. companies controlled about 35% of the output produced outside the U.S. But in contrast to the situation prevailing before the IWW, copper production was growing faster in areas not controlled by U.S. companies, and these areas had copper reserved to support mass production. Before the IWW the most important competitors of the U.S. were areas which could not increase their output due to the small size of their reserves.

It was also important that most of the new copper supply came from areas of lower cost of production than those of the U.S., though there are discrepancies about the magnitude of the difference due to the different basis on which the costs were estimated. But it can be said that the average cost of production in the U.S. was about 9 cents while those of the most important areas outside the U.S. fluctuated between 6 and 7 cents.

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(1) F.E. Richter. The Copper Industry in 1927. Review of Economic and Statistic. February 1928.



Such conditions of cost were a potential source of conflict. But the leading U.S. producers wanted to avoid confrontation because they were in a process of consolidation and vertical integration as already described; two of them had made significant investment in Chile. The Belgian Congo also wanted to avoid confrontation after having invested in Katanga for several years. The smaller U.S. companies had higher cost so they had a high price preference.

It was also an important fact that the U.S. was rapidly losing the quasi-monopoly position they had at electrolytic refining, in 1925 by 25% of the electrolytic facilities were located outside the U.S. and new projects were going to reduce even more the U.S. position. But an important part of the non U.S. production still had to be refined in the U.S.

Despite the fact that none of these situations were a serious threat to the U.S. dominance in the copper industry, the leading producers did not have a passive attitude to these changes of structure. Anaconda was trying to obtain access to the Belgium Congo copper deposits, and the interests represented by Guggenheim to the Northern Rhodesia reserves. The only copper deposits where the U.S. companies could not do anything to obtain access were the nickel-copper reserves of International Nickel Company which had a virtual monopoly in the nickel market and obviously it did not want to lose its position.

Before referring to the formation of the cartel it is important to consider the situation of the Northern Rhodesian copper deposits since part of the literature on cartels gives as an example of a cartel which permitted the entry of new producers, the one formed by the copper industry in this period (1). The hypothesis here are two: the first is that the investment in exploration which supported exploitation was made before the formation of the cartel, and the second is that the companies involved in Northern Rhodesia were interested in developing any economic copper deposit as far as the market conditions were normal.

In 1920 the copper deposits of Northern Rhodesia were already known but they were oxides whose development was not economic with the existing technology. In 1923, the owner of all the mineral rights of Northern Rhodesia, a British South African company, re-organised the mineral concessions in order to encourage prospecting activities in this area (2).

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(1) See for instance: UN, Department of Economic Affairs: International Cartels, 1947.

(2) A. Roberts: A History of Zambia . Heinemann. London 1976, page 185.

In 1924 Northern Rhodesia passed to the administrative control of the Crown: this situation implied a liberation of resources to the private company which had administered it hitherto. The institutional change and the "new resources" permitted an increase in investment in prospective activities. Between 1924 and 1926 about five million dollars were invested in exploration.

According to T. Gregory the decisive step was the decision to contract a U.S. geologist with experience in copper exploration who made the discoveries of sulfides in Nchanga and Roan Antelope (1).

However, the companies involved in the development of the Northern Rhodesia deposits had no experience in large-scale copper production, they had problems due to their rivalry and lack of understanding in the diamond industry and they also had difficulties in financing the whole operation. For these reasons E. Davis wrote to S. Guggenheim to ask the association of interest he represented (ASARCO and Kennecott) to exploit the Bwana M'Kubwa and the Rhodesian Broken Hill concessions: the reply stated "they are always interested in the possibility of acquiring the ownership control of any mine of known merit (whether the ownership control be secured by themselves or in association with others); they are not interested in what might be considered purely as a banking transaction, or in the under writing or purchase of the securities of a company with those management they are not connected" (2).

The U.S. companies were looking for majority participation in Northern Rhodesia. They had the know-how and expertise required and wanted to sell them at the best possible price.

The British South African company was interested in starting production as soon as possible in any deposit which was profitable in order to begin to recover the large investment already made in administrative activities. This was one of the areas in which there was a confrontation of interests between this company on the one side and the Kennecott and ASARCO on the other side. The problem as seen by the former, was that the large U.S. producers would postpone the development of the Rhodesian copper fields due to the conditions of balance between supply and demand for the next years. Although this was also a problem for the British South African interests, this was compensated for by the higher grade of the copper deposits, cheap cost of labour. Furthermore, they were not concerned with

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(1) T. Gregory: Ernest Oppenheimer and the Economic Development of Southern Africa. Oxford University Press, 1962, page 273.

(2) T. Gregory, Ob.cit., page 295.

the effect of the development of the new deposits on the profitability of other copper companies owned by them, as was the case of Kennecott.

The British South African opted for developing these deposits independently, gaining the support of the British government which was not interested in increasing the power that the U.S. companies already had in the copper industry, especially if such additional power implied postponing the development of an otherwise unproductive area of high administrative costs.

The decisions on the development of the Northern Rhodesian deposits were already made by early 1928: the cartel was operating but the prices of copper were almost the same than those prevailing by 1924-25. Obviously the British South African Company used the cartel affair to obtain greater support to accomplish their objectives: the cartel was controlled by U.S. interests and this was a situation which could be favourably used in a period of great nationalism as an additional argument to raise funds in the London market. But the cartel was not decisive at all in the development of the Northern Rhodesia copper deposits: this would have happened anyway.

The justification of the cartel was given by one of its protagonist in 1929, Mr C.F. Kelly, President of Anaconda, when he made a diagnosis of the copper industry. The central elements of his analysis were that production and consumption had reached a high record in 1925 but prices had failed to increase for two reasons:

- a) the intensively competitive effort of the various copper selling agencies both in the U.S. and abroad; and
- b) the activity of speculative dealers abroad whose available suppliers of copper have been during the past few years largely increased (1).

The legal antecedents of the cartel are related to a letter addressed to the U.S. Secretary of Trade by the American Silver Producers Association in November 1923. The letter contained five questions about the legal implications of the operation of a hypothetical association under the Webb-Komerene Act (2).

The reply was received in the second half of 1924 and was signed by the head of the Federal Trade Commission; this letter was addressed to C.F. Kelly who was not only a representative of the Silver Producers Committee but also the head of Anaconda. Three concepts of the answer

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(1) Engineering and Mining Journal, January 1929.

(2) TNEC Monograph No.6, EXPORT PRICES AND EXPORT CARTELS. pp.125-128.

were the most important in the organisation of a copper cartel; they are briefly summarized here: that an association cannot include residents and non-residents in the U.S., but that the U.S. members of an association could enter in contractual relation with non-residents for the sole purpose of operating in markets outside the U.S. and that the association would not require to perform all the operations of selling (1).

Copper Export Inc. was incorporated on 15th October 1926, but early that year "rumours were current that <sup>the</sup> Anaconda interest, aided by Katanga had already gone a long way toward forming a new copper export association" and by mid-summer it was reported that the new organisation was being held-up due to the delay in securing the approval of the Federal Trade Commission (2).

According to the certificate of incorporation of the Copper Exporter Inc., its objective was to "engage solely in export trade as the term "export trade" is defined in the Act of Congress entitled "An act to promote export trade and for other purposes" approved in April 19th, 1918 (3).

Press releases of the new association stressed more specific objectives: to eliminate middlemen in order to stabilise the prices of copper, because, according to the producers' point of view, dealers created wide price fluctuations motivated by speculative purposes.

Copper Export Inc., was organised in the U.S., and its members were copper producers of that country. The shareholders elected a Committee, based in New York, which defined the export policies of the association. Copper Export Inc. established contractual relations with the non-U.S. copper producers which in turn elected a second Committee, based in Brussels, which included representatives of the New York Committee. Any member of the European organisation had the right to send one delegate to the New York committee, but only as an adviser.

The cartel contracted an accountancy firm in Brussels which also had the function of compiling statistical information on the members of both Committees and measure their performance. Based on this information the New York Committee announced the standard electrolytic price referred to as C.I.F. Hamburg. This price was not absolutely binding for the members of the cartel, since a given percentage of their sales could be done below it. The sale function was performed by the same agencies used by the producers prior to the organisation of the cartel.

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(1) C.P. Fuller "The Copper Cartel" Harvard Business Review, April 1928.

(2) C.P. Fuller, Ob.cit.

(3) Federal Trade Commission: The Copper Industry, Ob.cit. page 208.

The conversion of the C.I.F. Hamburg price to F.O.B. New York was always (except for a couple of months) higher than the U.S. domestic price. This situation suggests that there was a division of the market, the U.S. members would exploit their national market while the others exploited the European market. The difference between the two prices had the function of a variable but small tariff.

The analysis of the cartel organisation would not be complete without mentioning the Copper Institute. The Institute was a trade association including the U.S. producers and their subsidiaries. It had three related functions: to compile statistical information, to analyse the market "of the copper and/or copper products" and "to submit to the members and others similarly concerned a standard system of accounting for the ascertainment of true cost" (1). The new organisation seems a duplication of the statistical function of the American Bureau of Metal Statistic, but it was really a complement, supplying information for shorter periods of time to the New York Committee. "Never before the producers had a better system of information than during Copper Export Inc." (2).

The cartel did not have a mechanism to curtail production or sales. This situation is largely explained by the anti-monopoly legislation of the U.S.

The general production and sales policy was that each producer should have to maintain its share in the market: monthly production had to be maintained at the same relative level of "the second, third and fourth month prior to the current month".

A concession was granted to the copper concerns controlled by European members; in this case, if the sale participation in any month was below the historical (second, third, fourth, month prior the current month), the European firm had to declare it and an additional sale participation would be granted.

Such a system could operate with small fluctuations in demand and/or demand reductions which lasted a short period of time due to the cumulative effect that such a system implied.

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- (1) From the Act of Constitution of the Copper Institute in C.P. Fuller The Copper Cartel. Harvard Business Review, April 1928.
  - (2) C.P. Fuller: The Copper Cartel, Ob.cit.

In order to avoid speculation and thus stabilize the price of copper, it was decided that the cartel should sell only to the consumers; both Committees approved a list of consumers: sales to other buyers would require the approval of both Committees. As a result or as an additional mechanism of this policy the sales to the United Kingdom were reduced during the first two years of operation of the cartel. One of the several implications of this policy was to make the already sophisticated system of operation and control of the cartel more complicated.

Copper Export Inc. controlled 85% of world mine production, 95% of the U.S. production and 74% of the total output outside the U.S. The U.S. companies controlled two-thirds of the output represented in the cartel; this percentage does not give a complete picture of the U.S. control: part of the production of the non-U.S. members of the cartel was refined in that country.

The 15% of production outside the cartel was supplied by small Canadian producers and companies which did not produce for the international market as in the case of Japan, Germany, USSR etc. It is noted that the potential influence of the outsider fringe was increased by the cartel policy of a white list of consumers.

Apart from the dealers of the United Kingdom, there was no adverse reaction against the cartel. This can be explained by the following facts: first, international trade was heavily cartelized and most of the industrialised countries were participating in them: second, the companies participating in the copper cartel had as their origin the most important consumer countries: third, the cartel did not increase prices immediately after its formation.

During the first two years of the cartel's operation (October 1926 - October 1928) the price was maintained at almost the same annual average of the years 1924 to 1926, that is 12 to 14 cents per pound. Skelton criticizes this policy as guilty of a sin of omission (1) but the analysis of that period does not support that statement. In 1927 world copper consumption increased by 33%, but in the U.S., there was a reduction of 7.9%, producers in the U.S. curtailed production; France reduced the amount of copper they used to buy and Copper Export Inc. decreased the shipments to the U.K. in order that stocks held in that country might be absorbed (2). On the supply

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(1) A. Skelton: Copper, Ob.cit., page 445.

(2) F.E. Richter: The Copper Industry in 1927. Review of Economic and Statistics February 1928.

side, new mines started production in Chile and Canada none of which had reached more than 50% of their capacity at the end of that year. In 1928 U.S. producers recovered their level of output and new mines began production: outside the U.S. production increased by more than 10%, most of the increase took place in Chile, the Belgium Congo and Canada where investments were maturing.

Table 4.12

World Copper Primary production 1925 - 32 (thousand tons)

Years	U.S.	Canada	Mexico	Chile	Congo	Rhodesia	Others	Total
1925	761	51	53	190	90	2	260	1,407
1926	783	61	56	202	81	2	283	1,468
1927	748	63	59	239	89	5	301	1,594
1928	821	92	67	290	112	5	331	1,718
1929	905	112	86	320	137	6	375	1,941
1930	639	138	73	220	139	10	385	1,604
1931	480	132	54	223	120	34	357	1,400
1932	216	112	35	229	54	89	298	1,033

Source: Year Book of American Metal Statistics.

To increase copper prices in this period would have implied curtailing production. But an agreement in such a matter would have been difficult in circumstances like recession in part of the market, new capacity of production starting to work and a process of absorption of stocks by consumers.

In August 1928, prices started to rise. Stocks held by the consumers had decreased to such a level that the market began to buy increasing amounts of copper. The peak price level was reached in March 1929 then prices began to fall to 18 cents, where they were stabilized between May 1929 and March 1930.

When the price started to increase, consumers began to react against the cartel. Aluminium was advertised as the raw material of Europe, creating the idea that copper was a product of the U.S. Some writers point out that at the end of 1929, a strike of the consumers began (1) but such a situation was due to the change in the market conditions and not to an organised reaction of the consumers.

(1) See for instance E.S. May: The Copper Industry in the U.S. Ob.cit, page 568.

In 1929, world copper production grew by 13% reaching the highest level of production until then. The U.S., Chilean and Belgian Congo producers worked at full capacity. But world copper consumption grew by only 1.7 per cent.

The LME quotations, referred to fire refined, followed the same trend as the price of the cartel until February 1929 but in March they began to fall and steeply. Only when the cartel announced a price of 17.8 cents per pound, the LME quotations stabilized between 15 and 16 cents; this situation remained until March 1930.

The economic crisis began in the last quarter of 1929; although the members of the cartel were not operating in the exchange, the LME quotations neither reflected the large accumulation of stocks nor the reduction of consumption. Several confluent factors explain this situation: a) the crisis affected with less intensity the European market than the U.S. as far as copper consumption is concerned; b) the cartel had suspended sales for four consecutive years to British dealers and merchants and it restricted sales to semi-manufacturing companies, so the operations in Britain probably did not entirely reflect the situation in the whole European market; c) the fire refined copper was not as important as electrolytic in terms of the volume of trade.

With the crisis the greatest disarticulation of the copper industry in its whole history started; factors which would have been unimportant in normal conditions abruptly became relevant; confrontation of interests among the different categories of producers were such that it was not possible to agree on common actions to deal with the change in the market conditions. The postponement of decisions determined that those to be adopted in the future had to be more drastic and made under more restrictive conditions. Uncertainty was greatly increased by the dynamism of the change and the adjustments which began to take place.

The cartelized price of 17.8 cents was maintained until the end of March 1930. An earlier reduction of price would have certainly had a marginal effect on consumption, but it would have reduced at least the output of the competitive fringe and that of the suppliers of secondary copper. The prices continued being reduced until they reached 10 cents in August, a level at which they were maintained until the end of the year.

In May 1930, the cartel met in New York, the non-U.S. suppliers did not agree to restrict their output, but the U.S. companies decided to cut output. The curtailment resulted in the following reductions by the end



of 1930: Anaconda 33%; Phelps Dodge 31%; Kennecott 45%; all the other U.S. producers 15%; which gives an average of 33%.

The U.S. subsidiaries in other countries reduced production by 27.7% but at different rates, namely 31.1% in Chile and 14% in Mexico (1)

All the non U.S. suppliers, both members and non-members of the cartel increased their output, obtaining record levels that year.

A new price policy was introduced, it incorporated a new element, the difference between the price of the cartel and the LME quotation was reduced from at least 2 cents to about 0.2 cents; this difference did not reflect the cost of conversion from fire refined to electrolytic. The new policy was due to the fact that the non members of the cartel had increased their sales of fire refined to avoid retaliation by the cartel, the non U.S. members of the cartel were doing the same without violating the rules of the cartel, which only fixed the price for electrolytic. As a result of this situation the U.S. net exports had already been negative in 1929 and in 1930 imports were again greater than exports in spite of the large idle capacity of the U.S. copper producers. Simultaneously, the U.S. primary producers started to increase pressures on the custom-smelters to reduce the service to the foreign suppliers which largely depended on the U.S. refineries to produce electrolytic copper.

But none of these actions could substitute an agreement among the producers to cope with the increasing unbalance between supply and demand. Agreement could not be reached on production curtailment for the following reasons:

- 1) The crisis affected with different intensity copper consumption in and outside the U.S., so not only producers' expectations were different but also the magnitude of the curtailment required, as it can be seen in Table 4.13

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1) The Mexican government reaction to the suggestion of the closure of the U.S. mines was an immediate threat of nationalisation. In the case of Chile it was not possible to find any type of reaction to the cut of production. At that time there was a liberal economic policy in Chile, there was no control on the activities of the copper companies except the one with an export duty that the companies paid as tax. The independence of action of the U.S. companies was such that a few years later one of the most prominent Chilean intellectuals wrote a book whose title is "Chuquicamata a Yankee State".

Table 4.13

World Copper Consumption in and outside the U.S.  
(thousand tons)

Years	United States		World Ex U.S.		Total	
	Quantity	% Variation	Quantity	% Variation	Quantity	% Variation
1929	797		927		1,724	
1930	565	-29.1	858	-7.4	1,423	-17.5
1931	424	-25.0	714	-16.8	1,138	-20.0
1932	244	-42.4	694	-2.8	938	-17.6
1933	274	12.3	809	16.6	1,083	15.5

Source: Year Book of the American Bureau of Metal Statistics.

- 2) The U.S. leading producers had a high price preference not only determined by their highest cost of production but also for the considerable financial commitment involved in the acquisition of semi-manufacturing facilities. The suppliers outside the U.S. had a lower cost so high prices were an incentive to increase output.
- 3) The investment in mining and processing facilities had mainly been made before the 1920s in the U.S. Outside this country about two-thirds of the total capital had been formed in the 1920s. The U.S. suppliers were in better conditions to reduce their output since fixed cost were a lower proportion of their total cost than outside the U.S.
- 4) Closely related to the different composition of the age of the capital of the industry there was another factor, the investment reaching the stage of production during the period of operation of the cartel and the outsiders to the cartel.

In the U.S., capacity of production declined by about 4 per cent in 1926-32: outside the U.S. it increased by 81% (1). The non U.S. suppliers did not restrict their output not only because they were pressed by new investment but also because the new production was competing for the same declining market.

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(1) About 50% of this capacity reached the market during the crisis, becoming an additional depressing pressure on prices.

Table 4.14

Capacity of Production at Mining  
(Thousand tons)

Years	In U.S.	Outside U.S.	Total
1926	904	850	1,754
1929	1,017	1,179	2,192
1932	875	1,542	2,417

In normal conditions it would have been difficult to absorb this extra capacity, not only because of its magnitude but also because a significant part was not controlled by members of the cartel.

About 20% of the additional capacity had been developed by the Canadians, where the major supplier, an outsider of the cartel, had made its decision of investment on the basis of the conditions prevailing in the nickel market, copper was a by-product. By the end of 1930, International Nickel Co., decided to co-operate with the cartel; this was after its main product was also being affected by the crisis, but also after one year of operating at full capacity which forced the other non US copper suppliers to maintain or to increase their production.

An additional problem of the negotiations on curtailment was imposed by some of the members of the cartel which had expanded their capacities. They rejected all the proposals which did not give special consideration to their additional capacity of production. Such a bargaining process considerably delayed an agreement in 1931 as will be seen.

Another 20-25 per cent of the new capacity was controlled by the two Rhodesians both of them new entrants and outsiders to the cartel. They started production in 1931, that is, a few months before the crisis reached its bottom. They were competing for the European market and started negotiations with the cartel, but the other firms which were reluctant to cut output without a compromise of the Rhodesian, in turn, the U.S. producers which had protected their market through the price policy of the cartel, did not reduce their output either, waiting for a compromise involving all the producers. But the agreement could only be reached when prices were falling below the cost of the most efficient producers.

However, it must be insisted that the price policy of the cartel did not promote investments. The development of a new copper mine takes about four years and in the best of the cases three years, so the last decisions on investment were made in 1927-28, that is, when the cartel had not increased the prices above those prevailing in 1924-25.

Apart from the Canadian and the Rhodesian, in the international market there was a large number of firms which mainly produced for their domestic market (in Germany, Scandinavia, Japan etc.). Despite that they were high cost producers none of them reduced output: the government subsidized their activities for employment or regional consideration. In normal conditions, their production would not have had any importance but in declining demand conditions their market share increased. For instance, the Japanese marginal fringe supplied 40-50% of the consumption before the crisis but 90% in 1931.

5) Among the U.S. producers there were also different strategic considerations. The higher cost producers launched a campaign for a tariff on copper almost immediately after the crisis started. In mid 1930, Phelps Dodge also began to support the tariff.

Other considerations were important to the companies with subsidiaries abroad. Anaconda and Kennecott's plants in South America had low cost, paid low taxes in Chile and the Chilean government did not intervene at all in their activities. These two companies supported international concerted action to face the crisis; tariff in the U.S. restricted flexibility to transfer production from their highest to their lowest cost plants. A tariff also implied the isolation of their subsidiaries which had to compete with European controlled companies for the European market, situation which was particularly important in a period of growing nationalism.

Afterwards both companies adopted a neutral position on the tariff. This was probably due to the fact that this strategy of concerted action failed. Moreover, as the crisis deepened the tariff gained political support, in such conditions these companies were not in conditions of shutting down their high cost plants maintaining in operation their foreign concerns without the risk of labour conflicts if not governmental intervention.

6) In the U.S. interest divergencies also existed between the primary producers and the custom-smelters. The formers' profits were highly dependent on the inelastic price of copper so they were interested in reducing production. The custom-smelters' profits were determined by the service they performed: higher prices of copper did not compensate the higher unit cost caused by the reduction of their volume of operation. When the U.S. copper producers curtailed their output, the custom-smelters began to increase the amount of secondary copper processed and to buy primary copper in the international market: to secure a quick disposal of their output the custom-smelters began to quote bargain prices (1).

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(1) F.E. Richter. The Copper Industry in 1930, page 18  
Review of Economic and Statistics, February 1931

The primary producers increased pressures on the custom-smelters to persuade them to reduce their operations. In November 1930, they met and agreed that smelters and refiners should not enter into new contracts which obliged them to buy or to treat copper on a toll basis from mines which produced more than 500 short tones monthly. It was also agreed that if the European custom-smelters did not accept the same basis, the U.S. smelters and refiners would be at liberty to compete on any basis with them.

The U.S. producers were using the custom-smelters as a mechanism to force the European producers, which eagerly relied on the U.S. refineries, to cut their output. They succeeded in the short term, but in the long run this decision forced the non U.S. suppliers to invest in electrolytic refineries. There is no information on refinery capacity for this period, but using the production peaks it can be said that the U.S. concentrated 74% of world capacity in 1926 and possibly only 55% in 1933.

The U.S. primary producers were unsuccessful in inducing the custom-smelters to reduce their secondary copper operations. In the same meeting it was agreed that the restrictive practice "shall not debar the parties from buying what is generally known as scrap copper on the daily quotation basis" (1).

As the U.S. copper consumption fell refined production of old scrap was reduced but at a lower rate than primary production, so as the crisis deepened the share of old scrap in consumption considerably increased as can be seen in Table 4.15 This was possible because the major component of the cost of scrap recovery were wages and salaries which started to fall after the crisis started.

Having defined the major areas of interest confrontation, it is easier to describe the evolution of Copper Exporter Inc.

In November 1930 the members of the cartel met officially for the second time since the crisis started. This time the Canadian producers participated in the meeting. But an additional restriction had been imposed by the Belgian and Canadian governments which had stated shortly before the meeting that the companies should not agree on curtailments which severely affected their mining communities.

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(1) Report of the Federal Trade Commission: The Copper Industry. Page 227.

Table 4.15U.S. Old Scrap Consumption as a percentage of Primary Consumption  
and Consumption of Primary and Secondary Copper

(in percentage)

Years	Old Scrap Primary Consumption	Old Scrap Consumption of Primary and Secondary Copper
1929	45.8	31.4
1930	54.9	35.4
1931	55.7	35.8
1932	63.5	38.8
1933	80.0	44.4

Sources: Skinner Ob.cit.: Statistical Appendix: Tables 5 and 8.

In several opportunities Union Miniere de Haut Katanga threatened to abandon the Conference. This company was one of the lowest cost producers, it had recently completed investments, it was directly affected by the action of outsiders which were absorbing part of its market; the Rhodesian were to start mass production in few months time. The Canadian producers were in the same situation but the crisis was drastically affecting nickel, so the major producer was forced to make output curtailments.

The U.S. companies were trying to force their rivals to cut production because the price was below their cost and any unilateral production reduction was not having any effect on the market if the major non U.S. suppliers increased their output as it had happened in 1930.

The conference finally agreed to cut output by 20,000 short tons per month, an amount which was lower than the average rate at which consumption fell in 1930, (30,000 short tons per month). Visible stocks were 6 months consumption, that is, four months in excess of their normal level, but the producers did not adopt any action to counteract the adverse effect on prices.

The curtailment decided in November permitted prices to remain at about 10 cents until March 1931, but consumption continued falling and stocks increasing at a growing rate.

The threat of a tariff in the U.S. was more important. Anaconda and Kennecott made additional efforts to incline the balance towards international concerted action as the only alternative to the tariff. But in a new Conference held in May no agreement was reached. The U.S. suppliers decided not to make further curtailments.

In this conference the new source of conflict was the fact that the Rhodesians had already sold copper in Europe. They asked quotas which were not accepted by their rivals. Curtailment without the Rhodesian were not approved by the other suppliers of the European market. The Rhodesians, in turn, were pressed by the significant financial commitment of their investment and they had three competitive advantages: the U.K. was their natural market; the cartel had antagonized European consumers in general and the British in particular so the Rhodesians were assured of strong support if they followed an independent policy; finally they had the lowest cost of production.

Prices and stocks continued moving in opposite directions in 1931; stocks were to reach 9.3 months consumption, 7.3 in excess normal conditions; prices were below the cost of most of the producers, 7 cents per pound. The financial situation of all the copper suppliers was extremely difficult.

In October 1931, there was another Conference. This time the copper companies decided to reduce production at 26.5% of the capacity of 1929. To impose price discipline was decided not only to set the price for electrolytic but also fire refined copper.

But aggregate demand continued falling, stocks increasing and prices dropped to 5.8 cents. In March 1932 the producers agreed to reduce production at 20% of 1929 capacity.

In May 1932 the US Congress approved a tariff on copper of 4 cents per pound which corresponded to 76.9% ad valorem at the price prevailing in that month.

The non US suppliers began to withdraw from the cartel as a protest against the tariff, disarticulating even more the copper industry. No company outside the US continued respecting the agreement of producing at 20% of the 1929 capacity of production. In 1931, the only producing area which made an important reduction of production was the Belgium Congo, but this was due to its high level of stocks.

The US tariff legalised the division in two of the world copper market, though such a division already existed as a result of the price policy imposed by the US suppliers within the cartel. The net U.S. copper imports were never important, only 6.9% of copper consumption in 1930 and 4.5% in 1931.

However, the tariff caused a qualitative change of the US suppliers which were motivated to coordinate their actions to increase the domestic price of copper above that of the international market by the amount of the tariff. The US producers could also dispose stocks in the international market by dumping exports. The tariff was also an indication of the political support gained by the copper producers; another was President Roosevelt statement that his aim was the restoration of commodity prices to the 1925-26 level (1).

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(1) The Time, February 17th, 1933, page 53.

Copper in those years had averaged about 12 cents which compared with the prevailing 5 cents.

The U.S. tariff caused reactions in other areas which were used by the non U.S. suppliers to obtain the maximum possible advantage.

In August 1932, the Ottawa Imperial Conference recommended a duty of £18.13s 4d per long ton on copper imported into the U.K., with Empire copper free of duty (1). This recommendation was rejected among other considerations because the U.K. was an important exporter of semi-manufactured copper so an increase of the price of the input above the European rivals simply meant that they were to lose their export market. Besides the Empire had passed to the category of net exporter of copper, a tariff on copper was to cause reactions in France where special treatment was to be granted to the Belgian producers. The Board of Trade called to meeting producers and consumers where it was decided that the U.K. semi-manufacturing industry was to purchase from Empire producers in preference to non-Empire suppliers (2).

France gave a preferential duty of 2% to the copper imported from Belgium or the Belgian Congo.

In November 1932, the suppliers of the international market met in New York but no agreement was reached (3) despite the price being only 4.8 cents per pound. The Rhodesian firms wanted to consolidate their market position in the U.K. which was also important for the Chilean subsidiary of Kennecott (4). Besides, Roan Antelope asked a greater quota to re-start operation in one of its mines, Mufulira. This was the last meeting of Copper Exporter Inc.

Most of the studies on Copper Exporter Inc., criticised the high price policy pursued by the cartel in 1928-30. Lower prices would have determined lower stocks strengthening the financial position of the producers to face the crisis. The criticism gives by granted that the costs of carrying the stocks were higher than the quasi-monopoly profits obtained by the members of the cartel, though no evidence has been raised on this respect. But admitting this assumption, the better financial position of the producers would have determined to postpone even more the relevant decision of the

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(1) The Economist, August 27th, 1932, page 386.

(2) The Economist, November 1st, 1932, page 115.

(3) The Economist, February 17th, 1933, page 53.

(4) The Economist, November 17th, 1932, page 1153.



suppliers, production curtailment. There is no doubt, however, that the prices were maintained at a high level for a relatively long period after the crisis started; but again, this criticism is valid ex-post, that is, knowing the evolution of all the relevant variables.

In an economic crisis the problem faced by a cartel is to distribute the economic and financial burden among their members. In the case of Copper Export Inc., the U.S. companies used their bargaining power to maintain their rivals outside their relevant market, the U.S.; and when drastic decisions were adopted the same curtailment was decided for the U.S. and non-U.S. suppliers, even though the crisis was less acute outside the U.S.

One of the features of the Copper Exporter Inc was the delay in deciding production curtailment determining the accumulation of surplus. The most restrictive factor was the constant arrival of new capacity which altered the position of the producers. But other factors also determined the lack of agreement:

- The effect of the crisis on copper consumption was less drastic outside the U.S.
- The large scale producers of the Belgian Congo, Canada, Chile and Rhodesia had lower cost than most of the mines in the U.S.
- The support of the government to the marginal fringe outside the U.S. which could maintain their output.
- The higher fixed cost of the suppliers outside the U.S.
- The necessity of securing a market for the new capacity of production.

Curtailement to balance supply and demand was finally agreed when prices were declining below the cost of the most efficient copper mines, reducing production to one-fourth, first, and later to one-fifth of the capacity of 1929. But this situation was inherently unstable: capacity of production was not removed from the market and the unit cost in all the producers must have considerably increased but especially of those which had recently completed their investment. A new change of the market conditions was enough to determine the collapse of the cartel: the tariff on copper in the U.S., despite this country was not an important market for none of the producers outside the U.S.

There is no doubt that the cartel was a failure and that the market conditions loosened at its control as early as 1930.

#### 4.8 The International Copper Cartel

1933 was the first year after the crisis in which world copper consumption increased; but output expanded at a higher rate than aggregate demand for the fifth consecutive year. Stocks of refined copper were about 7 months consumption (1) but in the U.S. they were equivalent to 12 months consumption while those held by the producers outside the U.S. were about 3 months. The LME quotations were 60% lower than the average prices of 1928-29.

In the International market producers were in a process of intense competition. They were operating at about 58% of their capacity (see table 4.16). Production grew faster than consumption and the average price was 2.5 per cent higher than that of the worst year of the crisis. The large scale producers were operating either at a loss or making a small profit (2) situation which was to be important in the formation of a new cartel. In these market conditions, the Rhodesian companies decided to resume operations in Mufulira; this mine had been shut down in 1931 due to problems in the dewatering system; after completing investment this mine was to have 70,000 tons capacity.

In Germany, due to the balance of payment deficits and strategic considerations, the government prohibited the use of copper in several articles and was promoting a campaign to replace it for aluminium (3).

In 1934 copper consumption augmented by 200,000 tons outside the U.S., output was again higher than demand, see table 4.17. In the international market prices fell to the same levels of the worst months of the crisis. The totally un-coordinated decisions of the producers were one of the causes, but this situation was also related to the market conditions prevailing in the U.S.

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(1) Brandeis, Goldschmidt and Company: Report on Copper. The Economist, February 19th, 1934.

(2) The Economist: May 19th, 1934, 1076-77; September 29, 593-94; November 24th, 1934, page 970.

(3) The Economist: February 13th, 1935, page 46.

Table 4.16

World Mine Capacity in 1933  
(thousands tons)

<u>Countries</u>	<u>Capacity - A</u>	<u>Production - B</u>	<u>B/A.100 - C</u>
United States	1016	212	21
Canada	203	134	66
Rhodesia	224	107	48
South America	406	197	49
Katanga	183	66	36
Europe	200	170	85
Mexico	61	40	66
Japan	71	69	87
All Others	71	44	62
TOTAL	2435	1039	43
World ex U.S.	1419	827	58

Sources: Capacity: Messrs. Brandeis Goldschmidt and Co. Copper in 1933. The Economist, February 17th, 1933, page 52.

Production: Year Book of the American Bureau of Metal Statistics.

In 1933 the U.S. was the country with higher idle capacity, 80 per cent; its industry was protected by the 4 cents tariff. the U.S. share in world production had fallen from 53% in 1926 to 20% in 1932. Copper consumption had remained almost constant since 1932 at about one quarter the level of 1929. However, the government was organising some economic activities according to the National Recovery Act (NRA), which authorised the formation of cartels operating under the surveillance of the government. The group of rules which regulated the activities of the copper producers (the copper code) was approved by the NRA authority in April 1934. The evolution of the U.S. copper industry in this period is not in the scope of this study (1), only those aspects relevant to the international market will be briefly considered here.

The U.S. cartel allocated quotas among the copper companies, freezing production at almost the 1933 level, but it fixed a price of 9 cents. It was also provided that none could sell copper from stocks until the entire quota of copper had been disposed. The effect of the code was to have the U.S. companies with the foreign market as their sole outlet for sales either from stocks or from output in excess of their sales quota, weakening the price in the international market; the suppliers outside the U.S.

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(1) Three classic studies cover the evolution of the copper industry in this period: E.S. May: The Copper Industry in the U.S., Ob.cit.; Federal Trade Commission: The Copper Industry. Ob.cit.: A.R. Burns: The Decline of Competition.

were defenseless since they could not retaliate due to the tariff. In 1934, the U.S. duty free exports (1) augmented by 100% causing the drastic price decline in the international market.

However, the new U.S. regulations do not entirely explain why the copper companies decided to expand their exports in 1934 and not before. The additional cause is related to the negotiations between Anaconda and Kennecott and the other suppliers of the international market.

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(1) Exports free of duty were those from ores mined in the U.S. They are distinguished from ores and blister sent to the U.S. for treatment: they paid the 4 cents tariff but the tax was refunded when the copper was re-exported.

Table 4.17

World Copper Production and Consumption 1933 - 1939  
(thousand tons)

Production

Years	United States	Canada	Rhodesia	Belgian Congo	Mexico	Chile	Peru	Japan	Others	World
1933	212	134	107	66	40	163	24	69	224	1039
1934	218	166	146	110	47	257	28	67	232	1271
1935	345	189	148	199	42	267	30	71	176	1467
1936	557	191	140	95	33	256	34	73	298	1677
1937	757	238	212	151	47	413	35	76	258	2263
1938	505	263	215	124	42	351	37	77	367	1981
1939	667	190	215	122	49	341	35	91	469	2179

Consumption

Years	United States	Great Britain	Germany	France	Italy	Japan	Others	World
1933	346	145	170	108	60	82	218	1129
1934	378	220	221	91	63	113	275	1361
1935	524	241	201	105	90	135	349	1645
1936	734	259	185	113	83	127	393	1894
1937	796	304	229	120	78	183	474	2184
1938	473	259	339	109	81	201	510	1972
1939	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Source: Year Book of American Bureau of Metal Statistics.

One of the most common versions about the antecedents of the formation of the third international cartel of the interwar period is based on the TNEC Hearings. According to the testimony of Mr E.T. Stannard, President of Kennecott Copper Corporation, he received a telephone call from Mr A.D. Storke, Managing Director of Roan Antelope and Mufulira Copper Mines in Rhodesia, to invite him and Mr C.F. Kelly, President of Anaconda, to discuss some form of cooperation on the copper market. Mr Stannard suggested that first the Rhodesian producers would have to solve their differences with the Belgian Congo suppliers. In February 1935, Mr Storke phoned again saying that they had solved their major difficulties and were ready to start conversation with the U.S. producers. The meeting culminated with an agreement early in 1935 (1).

(1) Based on R. Huxley International Cartels. Ob.cit.

Anaconda and Kennecott were the most interested in establishing a cooperative scheme in the international market where they had not an stable outlet for their subsidiaries. The most reluctant were the Rhodesians: the U.K. market could absorb their capacity, only time was required to penetrate it; besides they were also interested in completing the investment in Mufulira.

In September 1934 it was announced that according to unofficial reports, a meeting of the world copper producers was to take place in October (1). It was also reported that the copper producers had already met and one of the suggestions of the U.S. producers was that they should curtail exports if foreign producers agreed to some measure of restriction of output. As no agreement was reached, the monthly average exports free of duty increased by 28% in the second semester of 1934. Possibly, Anaconda and Kennecott retaliated.

In November 1934, it was reported that a group of British shareholders were anxious to obtain support for a new restriction scheme and formed the Copper Shareholders Association: the aim of this organisation was to offer "the strongest support to directors to come to such arrangements with other copper producers as will bring an end to the existing ruinous conditions, and to impress upon them the urgency of restoring a reasonable degree of both confidence and prosperity to the industry" (2).

In December one of the members of that Association published a letter addressed to the Director of The Economist in which the following question is formulated "Is a shareholder supposed to congratulate his directors on the wisdom of their inaction when he knows that a continuation of unfettered over-production will cause the copper prices to fall so low that every mine in the world will operate at a severe loss?". As a conclusion of his analysis he states that a shareholder "does not wish to pay for a war that may knock out rival companies" (3).

The objectives and motivations of the shareholders are well defined but the reason of their organisation in November 1934 may have well been that Anaconda and Kennecott made clear that if no agreement was reached they were to increase their exports and they were not to intercede with other U.S. copper companies to reduce theirs. As a matter of fact

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(1) The Economist, September 29th, 1934, page 593.

(2) The Economist, November 24th, 1934

(3) The Economist, December 8th, 1934.

In the first quarter of 1935, the monthly U.S. exports increased by another 28 per cent. Agreement was reached in March and U.S. exports were drastically reduced in the following months.

Unfortunately, there is not complete evidence that behind the copper exports increase were Anaconda and Kennecott; but the fact that exports were drastically reduced after the agreement suggest it, because no other producer was in condition to negotiate with the other U.S. producers. Obviously, this analysis is in complete contradiction with the solemn statement made under oath by Mr Stannard in the TNEC hearing.

Anaconda and Kennecott negotiating positions were considerably improved by the tariff; but both companies only used their bargaining power to come to terms with the other suppliers of the international market when world demand started to increase and the U.S. producers had already reached a production curtailment agreement.

The agreement among producers was reached in March 1935 and began to be put into practice in May 1935.

Two categories of participants were defined in the agreement: first, those with full membership privileges, that is to have the right to nominate a representative to the Committees with a right to vote; second, those without a right to vote but with right to attend the meetings of the Committees and to full information.

The members of the first group were: 1) Rhokana Corporation 2) Mufulira Copper Mines Ltd. and Roan Antelope Copper Mines Ltd. 3) Union Miniere du Haut Katanga 4) Braden Copper Co. (Kennecott). 5) Chile Exploration Co., Andes Copper Co., Green Cananea Copper Co. (Anaconda).

The Associated or co-operative members were: 1) Compagnie du Mines de Bor (located in Yugoslavia and owned by French). 2) Rio Tinto Ltd.

The objective of the cartel was "to bring about better conditions in the production, distribution and marketing of copper throughout the world outside of the U.S." (1). A more specific objective was defined in press releases "to adjust production of its members to meet consumption requirements outside the U.S." (2).

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(1) Memorandum of Provisions Covering Curtailment and Production Control of African, South American and European Producers. In TNEC, Hearings, Part 25, page 13528.

(2) The Economist, April 6th, 1935, page 782-83 and M. Kyriotis Les Cartels Internationaux, Librerie Technique et Economique, Paris. 1936.

The basic organisation of the cartel were two Committees and a Statistics Office or Clearing House. The most important functions of the Control Committee were first to increase or to reduce production according to a system of quotas previously agreed by the members of the cartel; second, to arrange the mechanism of gathering and distribution of statistics; third, to decide about complaints relative to alleged breaches of the operating rules (1).

The system of control of production established by the cartel defined standard quotas to each producer, specifying different levels of output at which the members were obliged, according to the discussion of the Control Committee. The basic tonnage were lower from the capacity of production of the participants. During the operation of the cartel the standard quotas were modified two times (see table 4.18).

The production agreement provided two gradual increases of the Mufulira's quotas (the first for the period January 1 - September 30, 1937 and the second for the period October 1 - June 30, 1938) but with a concomitant decrease of all the other members, except Anaconda (2).

The second Committee had as function to supervise and enforce the trade terms of the cartel. Probably due to the recent entry into the market of some members as well as the non-cooperative behaviour of the copper producers during the last years, the cartel gave priority to the establishment of trade practices as uniform as possible. It was provided that sales should be made as far as possible to the consumers in order to prevent speculation. Sales to dealers had to be reported to the cartel (3).

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- (1) The mechanism established by this cartel contrast with the relative complex procedures defined by other cartels. It was defined that "if the Committee, after a hearing and after full consideration, is that of the opinion that any participant has committed a breach it shall give notice to the offending participant to remedy the breach within a reasonable time fixed by the Committee.
  - (2) In 1938 when the agreement was renewed, Rhokana asked an additional quota and it was conceded.
  - (3) The device of direct sales to the consumers was established by the three interwar copper cartels: probably to maintain a tight control of sales and inventories.



Table 4.18Production Quotas for the members of the Cartel  
(short tons per month)A - First period: ending December 31st, 1936

	Chile-Andes Green Group	Katanga	Braden	Rhokana	Roan	Mufulira	Rio Tinto
Basic tonnage	18,500	11,000	10,976	6,720	6,720	3,730	3,172

B - Second period: (January 1st, 1937 to September 30th, 1937)

Basic tonnage	18,500	10,809	10,785	6,529	6,507	4,640	3,110
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C - Third period: (October 1st, 1937 to June 30th, 1938)

Basic tonnage	18,500	10,618	10,594	6,338	6,295	5,547	3,049
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Source: Memorandum of Provisions Covering Curtailment and Production Control.  
TNEC Hearing, Part 25, pages 13528-13531.

The Clearing House collected and provided statistical information on sales, stocks, etc. This function was co-ordinated by the Copper Institute in New York.

According to the regulations of the cartel, the control Committee defined the amounts of production to be curtailed by its members, taking into consideration the conditions of the market. The memorandum established that in the event that the curtailment was over 30 per cent, the committee should arrange those situations in which the quota of any supplier was insufficient to supply its contracts. And curtailment exceeding 40 per cent was voluntary.

The new cartel had important differences with Copper Exporter Inc. The latter operated on a world basis while the former functioned outside the U.S. This situation determined that the position of the U.S. suppliers was completely different within the cartel. In Copper Exporter Inc., the U.S. companies made the relevant decisions and the non U.S. copper producers had a subordinate role. Only two U.S. companies were members of the International Copper Cartel and the other members had equal rights and responsibilities.

The regulations of Copper Exporter Inc., defined norms and regulations for each type of possible situation, while the new cartel concentrated the definition of policies in the Control Committee, giving more flexibility to adapt the organisation to the changes in the market conditions.

Copper Exporter Inc., fixed the price and had not a system to control production as such. The new cartel emphasized the control of production and the price decisions were made by the companies. But both cartels tried to make the trade practices of their members more uniform.

Although in the International Copper Cartel the companies fixed the price, there was concensus of opinion among its members that all output restrictions should be removed if the price reached 45 or 50 sterling pounds. This was the result of several situations:

- a) The experience during the high price policy of Copper Exporter Inc.
- b) In the 1930s the average cost of production of the suppliers of the international market was much lower than in the second half of the 1920s.
- c) The restriction of the price policy of the companies:
  - The members of the cartel could not fix a price higher than that prevailing in the U.S., otherwise exports from this country were to increase. In turn, the U.S. government had already defined as domestic price policy goals the levels prevailing in 1925-26, that is, 12-13 cents of dollar per pound.
  - The important market share controlled by the outsiders to the cartel, some of which were low cost producers (the Canadians) or were protected by a tariff (the U.S.) or were subsidized by their governments (Germany, Japan etc).
  - The relatively high idle capacity both of the members of the cartel and the outsiders of the cartel, so a high price policy was to incentive output increase to the non members and cheating to the members of the cartel.

The members of the cartel represented only 10 mines, but controlled an important part of the market. Table 4.19 measures the percentage controlled by the cartel considering four alternative bases.

Table 4.19

Share of the market controlled by the members of the International  
copper cartel in 1935 - 1938(a)

<u>Production</u> (thousand ton)	1935	1936	1937	1938	1939
World	1467	1677	2263	1981	2179
World Ex U.S.	1122	1119	1505	1476	1512
World Ex U.S. & USSR	1058	1037	1416	1380	1405
World ex U.S. & USSR plus export free of duty from U.S.	1141	1086	1473	1494	1498
Production of the members of the cartel	507(b)	543	821	732	
Share of the market controlled by the cartel (percentage):					
World	34,6	32,4	36,3	37,0	
World Ex U.S.	45,2	48,5	54,6	49,6	
World Ex U.S. & USSR	47,9	52,4	59,0	53,0	
World Ex U.S. & USSR plus export free of duty from U.S.	44,4	50,0	55,7	49,0	

(a) Production of the cartel is copper smelted while all the other figures are mine production.

(b) It includes production for the year, but the cartel began to operate in March.

Sources: Production other than cartel: Year Book of the American Bureau of Metal Statistics.  
Production of the cartel: Information supplied by E.T. Stannard to the TNEC Hearings, part 25, Exhibit 2156, page 13528.

The most important producing countries outside the cartel were the U.S., Canada and Peru. Other countries were net importers as Japan or less important exporters as Australia or self sufficient as the USSR.

For the success of the cartel, the U.S. exports had fundamental importance, specially taking into account the low capacity of production in use in the U.S.; if this idle capacity was used to sell in the international market sooner rather than later the cartel would collapse. The initial negotiations to form the international cartel were easier because the U.S. companies were also operating a restrictive scheme in which Anaconda and Kennecott had a significant role. When the NRA was declared

unconstitutional in 1935, most of the reports on the copper industry suggested that the international copper cartel could collapse (1); but the U.S. copper companies continued operating on co-operative basis.

In the relations between the cartel and the suppliers of the international market, the leading position of Anaconda and Kennecott in both market was essential. The suppliers of the international market could not sell copper in the U.S., to retaliate against the U.S. companies, due to the tariff. But the policies of Anaconda and Kennecott were essential elements for the definition of the policies of all the other copper companies. For these two companies their profitable Chilean plans were important.

After the NRA, the anti-trust legislation started to be applied again; in this new situation the price difference between the international and the U.S. market became relevant. A great difference could have provoked suspicions of conspiracy, and this was an additional cause why the U.S. companies may have had to support the prices of the international cartel.

The corporate relations among the copper companies also must have been important. The other two important copper suppliers were ASARCO and Phelps Dodge. ASARCO had contractual and financial links with Kennecott, the Guggenheims owned shares in both companies, and the former treated the ores of the latter. The other important custom-smelter, American Metal Co. had interests in Roan Antelope (35 per cent of the shares) and Mufulira (66.7% of the shares), both of them members of the cartel.

Reports on the copper industry pointed out that there was agreement between the members of the cartel and the U.S. producers. U.S. sources of information stated that producers of that country would restrict their exports to 8 or 9 thousand tons per month (2) while in the U.K. the reports state that such a restriction would be at 4.5 thousand tons (3). In one of the TNEC Hearings, a representative of one of the U.S. companies denied the existence of such an agreement.

In 1935-37, the market share of the exports free of duty declined compared with the situation prevailing in 1934 (see table 4.20). It is also noted that neither Anaconda nor Kennecott exported from the U.S. in

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(1) The Economist, February 11th, 1935, page 46.

(2) Engineering and Mining Journal. Vol. 136, page 67. See also, A. Walker the International Copper Cartel.

(3) The Economist, April 6, 1935, page 783-784. In The Economist, 1st June 1935, an article states that the exports agreement was 3,600 tons.

1935-38. Although it is always difficult to prove the existence of a gentleman's agreement, in this case it is possible to say that the U.S. companies behaved as friendly outsiders.

Table 4.20

U.S. exports free of duty as percentage of production outside the  
U.S. and U.S.S.R.

Years	1934	1935	1936	1937	1938	1939
%	12.4	7.8	4.8	4.0	8.5	n/a

n/a; not available

source: Federal Trade Commission; The Copper Industry, Table 37, page 239.

The Canadian producers were not members of the cartel either but they were considered as cooperative outsiders. Most of the copper in their industry was mined in conjunction with nickel by International Nickel Co., the demand of its main product was expanding (1) (2). Noranda was a relatively small producer although it was investing, its capacity was not an important threat for the cartel. Co-operative relations were also made easier by direct and indirect corporate relations among the members of the cartel and the Canadian companies. American Metal through one Canadian subsidiary acted as manager of the copper refineries of International Nickel and it was the sales agent of its copper output. The selling agent of Noranda was the British Metal Corporation which was also a shareholder of Rhokana, one of the three Rhodesian producers (3).

Finally the output of the Peruvian mines, exploited by Cerro Corporation, was treated by American Metal Company in the U.S.

The cartel operated in a period in which there were at least three conflicts which almost ended in war. Most of the industrialised countries increased their expenditures on arms and, attending to the purchases of copper of some of them, they seem to have been accumulating strategic stocks as a mechanism of compensation of their non-possession of sources of primary copper in their own countries or in potential or real allies.

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(1) The Economist, February 11th, 1935, page 68.

(2) T.G. Gregory: Ob.cit.

(3) During this experience INCO reaffirmed in several opportunities its willingness to restrict its copper sales in periods of slow demand, see for instance The Economist, May 7th, 1938, page 320.

The cartel curtailed production to 80% of the agreed capacity in May 1, 1935 and to 70% from June 1, 1935. The latter represented a rate of production of 547,000 tons per year; it meant that the mines under the agreement were working at an average of 57% of their real capacity (1).

Reductions of production: decrease in exports from the U.S.; increase in consumption in the U.S. (by 38.6%) and in the rest of the world (by 14.0%) raised prices of copper and reduced stocks.

Table 4,21

Stocks in terms of months of consumption

Years	1933	1934	1935	1936	1937	1938
U.S.	16.2	10.1	5.3	2.5	3.5	6.6
Other Countries	2.2	2.4	2.2	1.7	1.4	1.1

In 1936 consumption increased by more than 200,000 tons. Stocks were at the lowest level since the crisis, but only in October 1936 the cartel started to make successive increases in the output quotas:

- to 65% from August 1st
- to 80% from October 15th
- to 95% from November 1st
- to 105% from November 5th (2)

In 1937 consumption outside the U.S. increased by 235,000 tons, that is, about 50% of the increase in consumption since 1928-29. This was an unprecedented increase for a single year of peace. The cartel withdrew output restrictions in January and the copper companies started to increase production almost immediately. However, in the first quarter of 1937 there were drastic changes in the price of copper, increasing from an average of £46 per ton in December 1936 to £72 in March 1937; at the highest daily quotation the prices were more than 100 per cent above the 1936 average; except in 1916, prices of copper had never been so swiftly. This situation can be explained both by the inelasticity of supply in the short term and by the fact the cartel determined increases in mine production

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(1) Production was fixed at an agreed capacity. For the period ending in December 1936, the basic tonnage (see table 4.18) represented 76% of the real capacity.

(2) The Economist: Commercial History and Review of 1936. Copper. February 13th, 1937, page 44-45.

which required a process of at least two months to reach the market as a refined product. In the next six months prices declined gradually to the levels considered as desirable by the cartel.

1937 was the first year in which consumption was higher than in the boom of 1929. The no restriction permitted a considerable increase in production, 34.6 per cent. But in the last months of 1937 an economic recession started. Only on the 1st October the cartel announced a restriction of output to 105 per cent of the agreed capacity but from the 1st December. The result was a volume of production higher than consumption and a downward trend of prices.

Table 4.22

Indices of Industrial Production in important copper consuming countries 1938 = 100

	<u>U.S.</u>	<u>Belgium</u>	<u>France</u>	<u>Germany</u>	<u>Italy</u>	<u>U.K.</u>
1933	78	82	101	52	73	75
1934	85	84	96	63	75	83
1935	98	94	94	73	87	90
1936	116	102	101	83	87	99
1937	127	111	108	93	101	107
1938	100	100	100	100	100	100

Source: OEEC Historical Indices of Industrial Production

As can be seen in Table 4.22 the recession affected with different intensity the industrialised countries. Probably this situation created different expectations among copper producers. The downward trend of prices continued during 1938, and could be stopped only in June after the cartel announced a reduction to 95 per cent of the basic tonnage.

U.S. copper consumption declined from about 75,000 tons monthly in the first half of 1937 to an average of nearly 24,000 per month in the first half of 1938 but in the final quarter increased to 58,000 tons (1).

In the U.S. the recession caused an increase of the stocks of copper from 145,000 tons in December 1936 to 263,000 by the end of 1937 and 332,000 in 1938. The U.S. copper companies rose exports free of duty as follows:

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(1) The Economist, February 7th, 1939.

Average monthly exports free of duty from the U.S.

(thousand tons)		
Year	Semester	tons
1936	2nd	4,1
1937	1st	4,7
	2nd	5,7
1938	1st	8,0
	2nd	12,9

Other outsiders of the cartel were increasing production and sales, especially the Canadians.

In May 1938, the copper producers had a Conference in London. No public statement was made, but possibly the U.S. exports were one of the subjects of the agenda. On the other side, a spokesman of International Nickel Company declared that this company was to restrict its sales of copper in times of low demand (1).

This period 1937-38 suggests that co-ordination between the members and outsiders of a cartel may be considerably affected when the market conditions experience abrupt changes, even when the mechanism of operation of a cartel are relatively simple as it was in this case.

The prices of copper could be maintained at about £40 per ton in the first quarter of 1938, falling to around £30-35 per ton in the second quarter. Only in July the quota was reduced to 95% of the agreed capacity. Restrictions were suspended due to threats of war in Europe which caused a recovery of the prices. With the lessening of the political tension the prices started to weaken, but the cartel reintroduced restrictions at 105 per cent of the basic tonnages and succeeded in maintaining the prices at about £45 a ton.

There is no monthly information for the first semester of 1939 except for prices and exports free of duty from U.S. It would be useless to try to analyse in detail this period without considering the political international context which preceded the outbreak of the World War Two. But this is out of the scope of this study.

The activities of the cartel ceased when the war broke out and the British Government fixed the price for copper.

During the operation of the cartel the average price of copper was £42 per tone while in the period of unrestricted competition (June 1932-March 1935) this average was £31, that is the cartelized prices were 35%

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(1) The Economist, May 7th. 1938, page 320.



higher. Except in the period of adjustment, in 1935, and early in 1937, the prices were relatively stable around the average. However, it must be noted that during the period of unrestricted competition the prices were more stable measuring both of them on the basis of the standard deviation.

It is not possible to define the level of prices at which the market would have operated in the absence of a cartel. Unrestricted competition is not a normal condition in a market in which production is concentrated in few producers all of them of low and similar level of cost, as in the international copper industry in this period. Thus in the absence of cartel, the producers would have used another mechanism of oligopolistic co-ordination and introduced restrictions of production. However, such agreements are difficult to implement when there are multiple market disequilibria, when some of the leading companies are new producers, and especially when the companies have different marketing practice as a result of a process of intense competition. Therefore, in the absence of the cartel, the prices would probably have been lower but higher than under intense competition.

The aggregate profit of the large scale producers must have increased considerably during the operation of the cartel. Assuming the average total cost at the relatively high level of 26 pounds a ton, the resulting average gross profit is 16 pounds per ton, against 5 in the period of unrestricted competition, assuming no variation in the average cost.

The International Copper Cartel reached most of the objectives defined by their members and was one of the most successful experiences on collusive agreements in the copper industry.

~~The Copper Export Association and the Copper International Cartel both of them maintained producers discipline with relative success in periods unfavourable for the producers.~~

~~No doubt, the alternative to the cartels would have been destructive competition and most likely all producers would have ended worse off.~~

~~Changes in market conditions made the adaptation of the cartel to the new situation always difficult augmenting the areas of rival confrontation or contradiction among the different categories of producers. The most important areas of divergent interests were between high and low cost producers; miners, custom smelters and vertically integrated producers; exporters of the total output and part of it; and the contradiction between new entrants and producers already established.~~

The greater the changes in demand and/or supply the more difficult it was to modify the policies by agreement and the greater the trend towards the maintenance of the status quo.

Finally the most difficult point. The cartel policies accelerated the speed of diffusion of some technological innovations or process already developed but concentrated in one geographical area. The cartel policies were not the only factor which influenced these processes but was one of them.

First, the high price policies of some cartels encouraged investors and financiers to take higher risks introducing new methods of production. Second, outsiders of the cartel or new entrants tried to maximize any possible competitive advantage in order to face their organised rivals. Third, when some members of one cartel used their strategic position of control of some process of production needed by the others to impose their decision, the group affected reacted deciding to invest in order to become independent of those companies.

Although it is not possible to generalize having only one case as a basis, this experience suggests that a cartel may succeed even when an important market share is controlled by outsiders. It also suggests that market co-ordination can become increasingly difficult when market conditions experience important changes.

#### 4.9 Conclusions

Nine cartels or combinations operating in the international market have been analysed in this chapter. Six of them prior First World War and three in the inter war period.

The study of these cartels implied the analysis of more than a century of the evolution of the copper industry, so every factor became a variable. The changes considered more important and related to the evolution of the cartel were briefly considered.

When the study of the evolution of each cartel do not suggest any conclusions or when there are differences between those drawn by people who had studied some of them, they are discussed at the end of the analysis of the cartel concerned. Here only the most general conclusions of the chapter will be considered. Seven out of nine combinations had a relatively short life, less than six years, which confirms the theoretical conclusion that this type of organisation lasts a short period, especially when there are important modifications of the market conditions.

Except the collusive agreements of the Swansea's smelters in the XIX century all the pre First World War combinations followed a similar pattern. They increased prices or tried to maintain them at a high level; newcomers into the market and/or the competitive fringe increased production, forcing further curtailment or increase the stocks to the combination. The cartel first lost part of its market share until they could not control the situation, thus causing its collapse.

The defeat of Copper Exporter Inc. was also related to new producers. In this case the entry was determined by competitive cost advantage of the new producers rather than the level of price chosen by the cartel. But the price policy of the cartel contributed to its final defeat.

New entrants were always reluctant to accept production restrictions and were always concerned with the possibility of capturing a market share which would enable them to operate at the highest possible scale of production and to obtain a cash-flow which allowed them to cover the high outflow caused by high fixed cost, payment of interest and amortizations.

The cartel policies were not always orientated to increase or maintain a high level of prices as was the case of the Copper Export Association and the International Copper Cartel. The latter implemented a ceiling price policy, withdrawing any production restriction when prices achieved a given level.

It is important to note that the policy of the three inter-war cartels was to control in the tightest possible way the level of stocks held by non producers. It seems that this policy was not only due to the effect of stocks on prices but also because stocks not held by producers limited their possibilities of action especially when demand fell.

It is always difficult to classify an organisation as successful, but here this concept will be limited to those organisations which accomplished their objectives from the stand point of view of the producers.

The objective of the Michigan Pool was to exploit monopoly power in the U.S. and they did so for nearly 13 years, maintaining a high level of profits and dividends (1).

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(1) J. Pierce suggests that this pool failed due to its collapse in 1886 and the loss of the leading position by the Michigan producers, but he ignores the long period in which that organisation exploited its monopoly power. Other analysts attribute the results (which they classified neither as successful nor as a failure) to the U.S. tariff and the support given by the politicians of Boston to the venture. But what really matters is that these groups of capitalists maximized their profits in the scenario in which their organisation was developed.

The Copper Export Association and the International Copper Cartel maintained producer discipline with relative success in periods unfavourable for the producers.

No doubt, the alternative to the cartels would have been destructive competition and most likely all producers would have ended worse off.

Changes in the market conditions made the adaptation of the cartel to the new situation always difficult, augmenting the areas of rival confrontation or contradiction among the different categories of producers. The most important areas of divergent interests were between high and low cost producers; miners custom smelters, and vertically integrated producers; exporters of the total output and part of it; and the contradiction between new entrants and producers already established.

The greater the changes in demand and/or supply the more difficult it was to modify the policies by agreement and the greater the maintenance of the status quo.

Finally the most difficult point. The cartel policies accelerated the speed of diffusion of some technological innovations or process already developed but concentrated in one geographical area. The cartel policies were not the only factor which influenced these processes but was one of them.

First, the high price policies of some cartels encouraged investors and financiers to take higher risks introducing new methods of production. Second, outsiders of the cartel or new entrants tried to maximize any possible competitive advantage in order to face their organised rivals. Third, when some members of one cartel used their strategic position of control of some process of production needed by the others to impose their decision, the group affected reacted deciding to invest in order to become independent of those companies.

Probably the reference to some concrete situation may reinforce these ideas.

- Bessemering was adopted from the steel industry by the new producers of Butte in the 1880's and its use rapidly extended when the Michigan Pool had a policy of high prices. At the end, the monopoly power of the pool was defeated by the lower cost of treatment of the new producers.

- The decision of establishing the first important electrolytic refinery was made when the Secretan Syndicate maintained high prices for copper.

- During the second attempt of exploiting monopoly power by the Amalgamated, mass production of the porphyry deposits started. Some of them had begun to be exploited by selective methods in the first attempt of the Amalgamated.

- The Northern Rhodesian producers found larger governmental and private financial support in Britain when Copper Exporter Inc., took measures against British dealers and later tried to influence the London Metal Exchange to exploit monopoly power. The Northern Rhodesian was the fourth area outside the U.S. which started mass production and the second not controlled entirely by U.S. companies.

- Until the crisis of 1929 the U.S. copper producers controlled more than 70% of world refinery capacity. Where demand fell abruptly they became increasingly interested in production curtailment. They tried to impose production restriction to the European companies and new producers reducing refinery services. Although there was world refinery capacity surplus, the European companies decided to invest in this process to become gradually independent of the U.S. refiners.

During the Second World War the European and the U.S. Governments took over the distribution of copper and fixed the price of this metal. It is not in the scope of this study the evolution of the industry under these abnormal conditions. But as a preliminary step to the analysis in Chapter 6 of the behaviour of the copper producers in the third quarter of this century, the drastic changes of the structure of the industry in 1950-75 are studied in the next chapter.

CHAPTER 5STRUCTURE OF THE COPPER INDUSTRY, 1950 - 1974.

Until the first half of the 1960s, the structure of the copper industry was relatively simple; few companies operated in a market in which prevailed indirect intervention of the governments; most of the companies were vertically integrated from mine to refining and some of them from mine to semi-manufacturing, so describing the structure one of the stages of production, and introducing some general explanations about the others the basic relations were defined. Besides, there were few producing countries, consumption of refined copper was more concentrated, and three countries Belgium, the U.K. and the U.S. had significant influence on the operation of the industry.

In a relatively short period of time most of the situation changed: the governments of some of the copper producing countries became directly involved in the industry, copper production began to be exploited in new countries, the leading companies experienced a drastic market share loss, the degree of vertical integration had a significant reduction; the patterns of copper trade changed, and the inter-company relations were drastically affected.

The causes of these changes were the nationalisations of the copper industry in some of the leading copper exporting nations and the reaction caused both in the copper consuming countries and in the companies involved in the industry. Another important factor was the uneven industrial growth in the world and in particular in the market economies, so that the derived demand for copper had a geographical shift; the most dynamic consuming countries opted for new strategies which took into account the changes which were taking place, causing new changes in the industry.

The emphasis of the analysis is given to the study of the structure of the private companies operating in the copper industry.

The separation of the structure of the industry from the behaviour is a disadvantage. But there is no alternative because of the dynamic changes in the structure in the last fifteen years, and the more complex character of the inter-relations among the copper producers.

The sequence of the chapter is as follows: structure of production and consumption by countries; structure of the international market; patterns of the international trade; vertical integration; structure of the industry by companies; corporate and company inter-relations.

Necessarily, the chapter devotes a good deal to measurement and description but there was no alternative without risking over simplification, especially since the study refers to a period characterised by relatively abrupt changes and there are few years which can be considered as "normal".

## 5.1 World Structure of production and consumption by Countries

### 5.1.1 The processes of production by group of countries

The analysis deals first with the world structure of production and consumption of copper classifying the countries in three groups: developed market economies (DME); under developed economies (UDE) and centrally planned economies (CPE).

The three stages of production (mining, smelting and refining) are considered separately since there are areas where intervention is in one of these processes but not in the others. This situation determines a relatively complex system of inter-relations whose characterisation is not only important to determine the capacity of negotiation (either as producers or consumers) but also because there are contradictions and sources of conflict among the producers of concentrates, the custom-smelters and vertically integrated units.

The analysis is referred to the period 1951-75 which was subdivided into five lustrums. Due to the important fluctuation of copper production and consumption the average of every five years were calculated to define trends. To detect possible changes in these trends, capacity of production of 1975, 1976 and projections to 1980 were used. The data on capacity are not entirely consistent with those of production, but fulfil their objectives; information on capacity of production beyond 1980 was considered unreliable.

The world structure of production and consumption by group of countries is presented in table 5.1. Several relevant characteristics become evident from the analysis of this table:

- 1) The CPE have considerably increased their market share at the four stages of production. The information on capacity of production suggests that this trend will continue. This group of countries mines and processes most of its requirements.
- 2) The DME have experienced a market share loss at all the stages of production, though greater at mining and consumption than at processing. They have become increasingly dependent on UDE for their supply of primary copper, this trend will continue according to the capacity of production expansion data.

3) The UDE maintained their position at mining and refining; at smelting they experienced a market share loss in 1965-75 but capacity of production projections suggests that they will recover the position they had in the early 1950s. At refining they will also improve their position. However, DME will maintain a significant position at all the stages of production, especially at processing.

Table 5.1

Group of Countries	Production (in percentage)					Capacity of Production		
	1951-55	1956-60	1961-65	1966-70	1971-75	1975	1976	1980
<b>a) Mining</b>								
Develop market economies (DME)	46.0	44.0	41.5	40.2	38.4	41.2	40.2	35.2
Under develop economies (UDE)	41.0	41.9	42.3	40.3	38.4	40.3	40.8	43.2
Centrally planned economies (CPE)	13.0	14.1	16.2	19.5	23.2	18.5	19.0	21.6
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
<b>b) Smelting</b>								
DME	52.5	52.3	50.7	50.5	49.0	51.0	51.0	47.3
UDE	34.8	34.2	34.6	31.7	28.4	31.0	30.3	34.6
CPE	12.7	13.5	14.7	17.8	21.1	18.0	18.7	18.1
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
<b>c) Refining</b>								
DME	n/a	65.5	64.5	61.2	57.8	62.3	61.9	55.7
UDE	n/a	17.6	18.0	18.8	18.9	21.5	21.7	28.0
CPE	n/a	16.9	17.5	20.0	23.3	16.2	16.4	16.3
TOTAL		100.0	100.0	100.0	100.0	100.0	100.0	100.0
<b>d) Consumption</b>								
DME	85.1	81.2	79.4	78.1	69.8			
UDE	3.8	4.1	4.1	3.4	6.1			
CPE	11.5	14.7	16.5	18.5	24.1			
TOTAL	100.0	100.0	100.0	100.0	100.0			

n/a: not available

a) The source of information on capacity of production adopted as a basis, it would seem, overestimate that of the U.S. for 1975-76 and under estimate that of the socialist countries. The projection for 1980 is also unfavourable for the socialist countries.

Sources: Production and consumption on the basis of the World Bureau of Metal Statistics: World Metal Statistics and the American Bureau of Metal Statistics: Non-Ferrous Metal Data (before 1974 this publication is known as the Yearbook). Capacity of production, 1975, 1976 and 1980 based on U.S. Bureau of Mines: Mineral Commodity Profiles, H.J. Schroeder: Copper-1977, Tables 1 and 2.



This pattern of location, primary production in UDE and processing in DME is not particular to the copper industry, it is also common to agriculture products and other mineral raw materials. However, this lack of integration in the primary source of production also has affected developed countries exporter of copper: Australia, Canada, as will see.

In the copper industry there is no simple explanation to this pattern of structure. Several considerations are taken into account to determine the location of processing plants: availability of energy, infrastructure and skilled labour, cost of labour, economies of scale, and cost of transport both of the input and output. In some stages of production, cost of transport is the determinant: the copper content of the mineral is so low (1.2 per cent) that the plant of concentration has to be located close to the source of extraction of the mineral. The copper content of concentrates varies from 25 to 33 per cent, this also determines that smelting generally takes place near the plant of concentration. The change in pattern of the mid 1960s is explained later.

The difference in weight between blister and refined copper is marginal so purely transport considerations do not determine their location.

However, other factors have also been important in the pattern of location.

The copper mining industry has been developed by foreign companies in UDE which are commonly considered unstable from a political and economic point of view. By investing in processing plants in their home-markets, the foreign companies reduce risk and increase their bargaining power; a primary producer becomes tied to its processing plant: it would take a considerable period of time to change to another processor: for instance when the Zairean government nationalised its copper industry and negotiations broke-down with Union Miniere, the latter disrupted processing of copper in Belgium from Zaire as one of the mechanisms of pressure; Zaire had no alternative plant to process about 50 per cent of its copper production.

Another factor which explains the location of refining facilities in industrialised countries is the necessity of refining secondary copper both new and old scrap. The motivation of the foreign companies is clear, to maintain a greater control of the market. Moreover, they can also process minerals from mines whose scale of production are not large enough to justify investment in processing plants.

This policy usually has the support of their home government for their contribution to employment, generation of value added, and foreign exchange saving.

Let us consider now the process which has taken place in developing countries in smelting. Before 1965, less than a fifth of the copper extracted in the UDC was smelted in the DME; this proportion increased to almost 30 per cent in 1970-75 and according to the information on capacity expansion it will experience a reduction by the 1980s. The first change was due to the revolution of the transport in the 1960s which caused a considerable reduction in the average cost of transport permitting concentrates to be smelted in DME. The second factor was the entry of the Japanese into smelting of copper produced overseas; the analysis of this situation is postponed until the next chapter. The reversal of the process in the late 1970s is due firstly to the increase in cost of transport as a result of the energy crisis; secondly, to the pollution control introduced in DME; thirdly downstream integration programmes implemented by the governments of some UDE, mainly the members of the Intergovernmental Council of Copper Exporting Countries (CIPEC).

This last factor also explains the change in the pattern of investment at refinery in the 1970s, as reflected in capacity expansion projections; UDE will also increase their share at this stage of production.

Finally the analysis will be focused on copper consumption by group of countries. World share copper consumption of the DME had an important reduction during the period; in the last lustrum, this reduction reflects the economic recession which affected the market economies. The CPE had the same trend that in production, a persistent increase during the whole period.

Information on copper consumption of the UDE is less accurate than statistics of production. It also must be noted that in the 1950s South Africa was classified in this group due to the lack of information for the first years of the period. Nevertheless, copper consumption has a trend to increase in these countries, but their share had important fluctuations which can be explained by two reasons: the economy of these countries is more unstable than those of the other two groups and during some years of the period, Chile exported important amounts of rod copper but as the result of special factors.

If the analysis is concentrated on the market economy countries, it is possible to note that about 93% of the copper is consumed in the industrialised nations which have 84.5% of the GDP and 26.5% of the population.

Table 5.2

Gross domestic product (GDP) population and consumption of refined copper in the market economies countries

Countries	GDP		Population* in millions	Average Copper Consumption in 1971-1975.	
	Total in millions U.S.	Per capita in U.S.		Total Thousand Tons	Per capita Kilogrammes
Developed	3,253,700	4,490	724.6	4.237	5.9
Under developed	600,900	300	2,003,0	370	0.2
TOTAL	3,854.600	1,410	2,727,6	4.607	1.7

\* Population considered is the number of inhabitants implicit in the GDP per capita: it implies approximations made by the UN.

Source: GDP: UN Annual Year Book 1975.

Five factors explain why the concentration of consumption of refined copper is higher in the DME than that of the GDP:

a) Copper consumption usually starts when there is a certain degree of industrialisation, in particular when there exists an institutional, productive and economic basis which permits the development of the engineering and electrical industry at levels which can absorb the minimum scale of production of wrought copper. Most of the UDE have not arrived yet at such a level of development (1).

This suggests that a wrought copper industry in UDC would have to be based purely on exports market. This is in circumstances that semi-manufacturing involves the production of a large variety of products of different sizes; a situation which contrasts with production and export of refined copper which basically is an homogeneous product.

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(1) It is not suggested here that there is only one pattern of development or industrialisation; the historical experience suggests that the possibilities are enormous, but the considerations made here are based on the more general pattern; first development from the most simple to the most complex technologies. The production of consumer goods starts first and later the production of capital products.

- b) The distance to the final market is more important for semi-manufacture-copper products than for unwrought copper since shipping rates are generally fixed in relation to the weight, volume and value of the cargo, so wrought products cost of transport must be more expensive.
- c) The technology of production is relatively simple, so most of the consumers countries prefer to develop their plants in their home market as a contribution to employment, value added and foreign exchange revenue saving.
- d) Except in the U.S., there are no taxes on unwrought copper imports in the market economies, but wrought copper is subject to relatively high tariffs in most of the large consuming countries. On the basis of studies on tariffs referred to the 1960s (1) it would seem that the rates have not tended to decline in the last 15 years.

The net exporting nations have repeatedly expressed their concern about the tariff on the semi-manufacturing industry (2). This is an area where there is coincidence of interest among the net exporting countries and may be one of the basis for a common policy.

To assess the magnitude of the tariff, the situation of the EEC will be considered (in the U.S. the import duties on wrought copper are similar while those of the Japanese are higher)(3). The EEC's tariff system, prevailing since June 1977, is presented in table 5.3. It consists on ad-valorem taxes and duty free import quotas for developing countries. The import quotas are fixed on monetary terms or on the basis of a formula which basically consists on the value of the imports in 1974 and/or 1972 (4). The duty free imports from any country can not be higher than 30 or 50 per cent of the quota for the whole EEC; on imports over such amounts the Common Custom Tariff is imposed.

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(1) Sergio Bavesi: The US Tariff Structure: Estimate of Effective Rate of Protection of US Industries and Industrial Labour. Review of Economics and Statistics. Vol.48, 1966, pages 147-160.

Bella Ballasa: Tariff Protection in Industrialised Countries. An Evaluation. Journal of Political Economy, Vol.73, December 1965, pages 573-895.

(2) UNCTAD Secretariat, The Processing of Primary Commodities by Developing Countries (TD/B/C, 1/197).

(3) A.M. Ritter: Conflict and Coincidence of Canadian and Less Developed Countries in International Commodity Trade in Primary Commodities. Discussion Paper 109. March 1978,

(4) Official Journal of the EEC: L349, December 20, 1976.

Table 5.3

EEC Tariffs on copper

<u>Items</u>	<u>Common custom Tariff</u>	<u>Quota Ceiling</u>
74.01 Copper mate: unwrought copper (refined or not) copper waste or scrap	Free	
74.02 Master alloys	Free	
74.03 Wrought, bars, rods, angles shapes sections and copper wire.	8%	Imports free to a ceiling of 6,294,000 v.a. 50% limit on any one country of origin, reduced to 1,095,000 u.a. for Yugoslavia.
74.04 Wrought plates, sheets and strip copper.	8%	Imports free to GSP (a): ceiling based on formula. Not more than 30% to come from one country of origin.
74.05 Copper foil not exceeding 0,15mm thick	8%	As 74.04 except that ceiling from any one country of origin is 50%.
74.06 Copper powders and flakes.	10%	As 74.05
74.07 Tubes, pipes and blanks therefore, hollow bars.	8%	Ceiling of 7,132,000 v.a. for GSP (a) countries. Limit of 30% from anyone country of origin.
74.08 Tube and pipe fittings of copper	7.5%	As 74.05

(a) GSP: Generalised Systems of Preferences

To evaluate the concession given to developing countries, let us consider the item 74.03, the most important in terms of volume of trade and production. Using the lowest price of copper in 1977, a developing country could export about 3,000 tons free of duty to the EEC, volume too insignificant to give more attention to this concession.

Using the U.K. value-added production ratios of the production of insulated wires and cables of the period 1971-73 (1) the resulting effective rate of protection is 23.5 per cent and for non-insulated cables 26.5 per cent. If the U.K.'s ratios are considered representative of those of other EEC countries, this would mean that a developing country would have

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(1) E.G. Wool: Comparative Performance of British Industries. Graham L. Tratman, 1975.

to reduce the value added of its exports by about 25 per cent to sell it at the same price as a U.K. semi-manufacturer.

It is difficult to assess to what extent the elimination of these barriers to trade would expand the export of semi-manufactured products from primary producing countries. There are no feasibility studies, and hypothetical assumptions on elasticity of supply would not give any reliable result. But it can be said that the existence of the tariff is a factor which makes considerably difficult the export of wrought copper from primary producers.

### 5.1.2 The processes of production by countries

#### 5.1.2.1 Mining

Six producers concentrate more than 70% of world output. The leading producers, as a group, have experienced a reduction of importance in their world share as it can be seen in table 5.4

Table 5.4

#### Concentration of copper production in the six leading producing countries (a)

Countries	(in percentage)					Capacity
	1951-55	1956-60	1961-65	1966-70	1971-75	1975
Canada	9.3	11.2	9.4	9.8	10.3	10.6
Chile	13.9	13.6	12.9	12.1	10.8	10.3
USSR	10.9	11.4	12.2	14.7	15.0	n/a
U.S.	29.9	25.2	24.7	22.9	19.8	21.7
Zaire	7.6	7.1	6.2	6.2	6.3	6.7
Zambia	12.7	12.8	13.4	12.2	9.6	9.2
TOTAL	84.3	81.3	78.8	77.9	71.8	-

n/a : not available

(a) Colonial territories are considered as one country before they obtained their independence.

Sources: Production on the basis of the World Bureau of Metal Statistics (WBMS): World Metal Statistic and the American Bureau of Metal Statistics (AB of MS): Non-Ferrous Metal Data several issues.  
Capacity of production on the basis of U.S. Bureau of Mines: Copper - 1977.

Except the USSR and Canada, these countries reduced their share in world output. The most important changes have been experienced by the USSR and the U.S., but in opposite directions. Despite the erosion of the production share of the U.S., it maintained its position as world producer leader. The USSR passed from the fourth to the second position in order of importance.

Considering the three under-developed countries together and comparing the extreme years of the period, it results in a net loss of 7.1%, that is, nearly 570,000 tons of the average production of the last lustrum of the period which is higher than the production of Zaire.

Another two relevant characteristics have been 1) the development of producers which were marginal in the 1950s and 2) new areas becoming copper producers.

In the first group, there are four countries (Australia, Peru, Philippines and South Africa), which concentrated 6.2% of world copper in 1951-55 and 11.1% in 1971-75. It is noted that the expansion of Cuajone and Cerro Verde are not reflected in these data; both mines considerably expanded the Peruvian output in 1976-77.

For the second group (new copper producer countries), the date on which large scale production began and their share in world output are specified below:

- Poland, 1969, 3.4% This country has still projects which have to reach the stage of production.
- Indonesia, 1972, 0.9%
- Papua, New Guinea, 1972, 2.2%

Moreover, Iran was to begin production of copper in 1978 and Mexico will considerably increase its output in 1979.

Panama and Mongolia will become copper producers in the 1980s.

Brazil and India were to begin copper production, in 1977-78; their projects are relatively small but it would permit them to supply a significant part of their own requirements (1).

#### 5.1.2.2 Smelting

Smelter production is highly concentrated in eight countries. Their market share of world output has also experienced a gradual and constant reduction but it has not been as important as in mining.

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(1) In Brazil the project is Caraiba Metais, which is being developed by a state owned company, Financiamentos de Insumos Basicos (FIBASE). It is a mine of about 65,000 tons capacity. Several dates has been given for its start up, one of the latest was 1979. Domestic production will supply about one-third of her domestic consumption.

In India the Ketri copper Project in Rhajasthan, 31,000 tons capacity. It was to begin production in 1976, that is, ten years after it was planned. However, its output was not reflected in the 1976 and 1977, statistics of the World Bureau of Metal Statistic and American Bureau of Metal Statistics.

However, if the analysis is concentrated in the primary producers it can be concluded that they have experienced a significant loss.

Table 5.5

World Concentration of smelting production, by countries  
(in percentage)

Countries	1951-55	1956-60	1961-65	1966-70	1971-75	Capacity of production 1975
a) <u>Primary Producers</u>						
Canada	7.4	7.8	7.0	6.8	6.3	6.6
Chile	12.3	11.9	11.9	10.2	8.7	8.5
USSR	10.2	10.6	11.0	13.2	14.7	n/a
U.S.	31.5	27.7	25.5	21.5	19.4	19.5
Zaire	7.2	6.6	5.7	5.5	5.9	5.8
Zambia	11.7	11.6	12.0	10.0	9.0	9.1
SUB-TOTAL (a)	80.3	76.2	72.3	67.8	64.0	-
b) <u>Custom Smelters</u>						
Germany FR	7.4	6.6	6.4	6.5	4.4	5.0 *
Japan	2.0	4.6	6.2	8.9	11.4	12.0 *
SUB-TOTAL (b)	9.4	11.2	12.6	15.4	15.8	17.0
TOTAL (a+b)	89.7	87.4	84.9	83.2	79.8	-

\* : estimations

n/a : not available,

Sources: Production: on the basis of WBMS and AB of MS; Ob.cit.  
Capacity of production based on U.S. Bureau of Mines; Copper 1977.

Among the leading smelters there are two countries whose primary production is marginal, Japan and Germany, both of them process copper produced overseas. Japan developed its smelter industry in this period. Both of them are custom-smelters, that is, treat the primary production of others, either previous purchase of the raw material or on a toll basis.

The only two countries which experienced an improvement of their position were the USSR and Japan. The latter did it at a spectacular rate of growth, resulting in an increase of 470%. All the other countries of this group experienced a market share reduction, the most significant of all occurred in the U.S.



5.1.2.3 Refining (1)

Although refined copper production mainly takes place in ten countries it is less concentrated than mine and smelter production. The leading producers also had a reduction of their weight, but far less significant than at the other two stages of production.

Table 5.6

World concentration of refinery production by countries  
(in percentage)

a) <u>Primary Producers</u>	1956-60	1961-65	1966-70	1971-75	Capacity of production 1975
Canada	7.4	6.5	6.6	6.2	6.0
Chile	5.1	4.7	6.1	5.9	7.6
USSR	12.0	12.1	14.7	15.5	-
U.S.	33.4	31.8	27.0	23.1	25.0
Zaire	3.4	3.0	3.5	2.7	2.5
Zambia	7.2	8.3	8.2	7.5	7.3
SUB-TOTAL	68.5	66.4	66.1	60.9	-
b) <u>Custom Smelters</u>					
Belgium	4.0	4.7	4.6	4.2	} 12.0
Germany	6.3	5.9	5.7	5.0	
U.K.	4.7	4.2	2.8	2.0	
Japan	4.0	5.6	8.2	10.5	12.0
SUB-TOTAL	19.0	20.4	21.3	21.7	24.0
TOTAL	87.5	86.8	87.4	82.6	-

Sources: Production on the basis of the UBMS and WB of MS: Ob.cit.  
Capacity of production: based on U.S. Bureau of Mines: Copper 1977.

The six leading primary producers also experienced a loss of their position though capacity of production projections suggest that they will recover it in 1980. Within this group the two changes already noted at refining and smelting are also present: while the USSR improved her position that of the U.S. persistently fell along the period.

(1) Structure of production of refinery is analysed for the period 1956-60 and 1971-75. Datas for 1951-55 are not always reliable or based on homogeneous information.

The number of countries with important custom-smelter industry increase with respect to smelting. At refining the custom-smelters as a group, basically maintained their position though significant changes can be observed, the U.K. had a market share loss while the Japanese improved theirs. Data on capacity of production projections suggest a small improvement of their position in 1980.

#### 5.1.2.4 Copper consumption

Copper consumption is also highly concentrated in five countries; but their world share has decreased persistently. The relative importance of the countries has also changed considerably through the period. USSR and Japan passed from the third and sixth position in 1951-55 to the second and third places in 1971-75, respectively. The U.S. continues being the leading consumer country, but after losing an important world share; it is also significant the change of the position of the U.K., from the second to fifth place, this may be explained by the economic disturbances which had been affecting this country.

Table 5.7

#### Concentration of copper consumption by countries (in percentage)

Countries	1951-55	1956-60	1961-65	1966-70	1971-75
France	4.7	5.3	5.2	5.0	4.8
Germany	8.1	11.0	10.6	9.8	8.5
Japan	3.2	5.0	7.2	11.3	11.5
USSR	9.5	10.5	11.6	11.9	14.0
U.K.	12.7	13.3	11.5	9.0	6.4
U.S.	41.8	32.0	29.1	27.7	23.7
<b>SUB-TOTAL</b>	<b>80.0</b>	<b>77.1</b>	<b>75.2</b>	<b>74.7</b>	<b>68.9</b>
Other centrally planned economies	2.0	3.2	4.9	6.6	10.1
Other market economies of Europe	9.5	10.5	11.0	10.3	10.6
<b>SUB-TOTAL</b>	<b>11.5</b>	<b>13.7</b>	<b>15.9</b>	<b>16.9</b>	<b>20.7</b>
<b>TOTAL</b>	<b>91.5</b>	<b>90.8</b>	<b>91.1</b>	<b>91.6</b>	<b>89.6</b>

Sources: on the basis of the WBMS and AB of MS: Ob.cit.

It must be noted that changes also have taken place in other European countries. Italy and Spain have increased substantially their share.

The per capita consumption of copper and the average rate of growth in those market economies areas which consumed more than 350,000 tons are presented in table 5.8. It is possible to note that per capita consumption has tended to equalise among these countries. Second, the rate of growth has been faster in areas almost totally dependent on foreign sources of supply, this suggests an increase in competition for raw material supplies. Third, the rate of growth has been faster in areas where the final uses of copper have expanded on the basis of exports or at least where exports have had a significant role in the expansion of these sectors; this may have added dynamism to the expansion of copper but at the same time it may be an additional element on instability, whose role has not yet been studied; further analysis would be required on this subject.

Table 5,8

Per capital consumption and rate of growth in some market economies

Countries	(Kilogrammes per head)						Rate of growth	
	1950	1955	1960	1965	1970	1976	(%)	(a)
France	2.77	4.26	5.26	5.90	6.52	6.89	3.09	
Germany	3.63	7.03	9.30	9.07	11.38	11.82	3.85	
Italy	1.31	1.81	3.72	3.70	4.54	5.73	5.95	
Japan	0.77	1.27	3.27	4.30	7.88	9.37	11.47	
U.K.	6.76	9.84	10.70	11.93	9.87	8.10	0.5	
U.S.	8.48	8.21	7.03	9.61	9.03	8.20	1.17	

(a) To calculate the rate of growth a line was adjusted to the values of the table.

Sources: on the basis of WB of MS and UN; Ob.cit.

Constraining the analysis to the market economies in 1964-74 it is possible to compare the evolution of copper consumption of refined copper with macroeconomic variables.

It is noted that statistics on copper consumption have limitations due to the inadequate information on inventories which are relatively sensitive to price variations, the only possibility of overcoming partially the problem is to consider a period large enough in order that variations compensate each other.

Table 5.9 presents average rate of growth of three macroeconomics variables (Gross Domestic Product, Gross Fixed Capital Formation, Manufacturing), and of consumption of refined copper. Elasticity of growth can be defined as the coefficient which reflects the change in refined copper consumption when the economic variable considered increases by one per cent.

Table 5.9

Rate of growth of GDP, Gross Fixed Capital, Manufacturing at Constant prices and volume of refined copper consumption, elasticities of growth of copper consumption, 1967 - 1974. (rates of growth in percentage)

Countries	<u>Rates of Growth</u>				<u>Elasticities of growth</u>		
	GDP(1)	GFCF(2)	Manuf.	Consumption	GDP	GFCF	Manufacturing
Unit. States(3)	3.5	3.6	3.9	2.3	0.657	0.639	0.590
Canada	5.1	4.8	5.6	3.6	0.706	0.750	0.643
France	5.6	7.0	6.6(4)	3.8	0.679	0.543	0.613
Germany	4.4	3.9	5.2	3.4	0.773	0.872	0.654
Italy	4.8	4.4	6.7(4)	4.8	1.000	1.091	0.716
U.K.	2.5	2.8	2.6	-2.4	-0.960	-0.857	-0.923
Japan	9.7	12.8	n/a(5)	7.9	0.814	0.617	-
Market economies	4.6	5.4	5.7	2.9	0.630	0.537	0.509

(1) GDP: Gross Domestic Product.

(2) GFCF : Gross Fixed Capital Formation.

(3) United States: 1964-73.

(4) Industrial Activity.

(5) n/a : not available.

Sources: GDP, GFCF, Manufacturing: UN Year Book of National Accounts Statistics, 1975.

Copper Consumption: Based on statistic tables of the WBMS.

Copper consumption grew at a lower rate than GDP in all the countries considered except Italy where the consumption base was relatively low. The coefficients are still lower when they are calculated in relation to manufacturing. The factors which explain such a situation were already discussed in chapter 2: they are related to innovations in technology which tend to reduce the amount of copper per unit of final goods and gradually increase the possibilities of using substitutes in some final uses.

## 5.2 The International Copper Trade

The analysis is restricted to the period 1964-74 because desaggregate information on exports and imports of copper is less reliable for 1950-63. The CPE are considered as one unit because there is less information about the intra socialist trade.

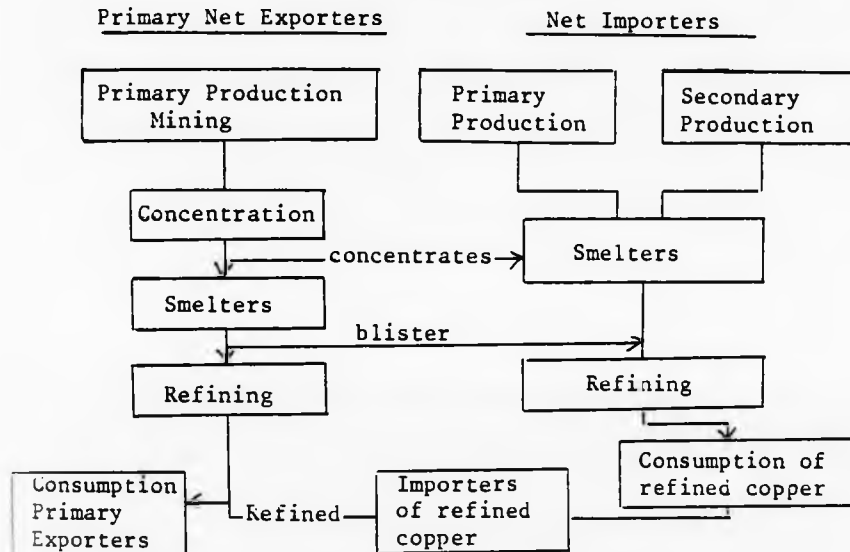
As suggested in the analysis of the structure of production of the copper industry, the market share of primary producers which export most of their output decreases as the degree of elaboration of the product augments, increasing in turn the share of the net importers. This structure determines a relatively complex system of inter-relations between the importing and exporting nations.

Figure 1 is a simplified chart flow of the most general patterns of the international copper trade. The participants have been classified in two groups, net exporters and net importers. The net exporters sell their output as concentrates, blister or refined copper. Net importers have primary and secondary sources of supply, but they are relatively small in relation to their consumption; they are highly dependent on foreign sources of supply, but to different degrees; the U.S. has imported between 4 to 10 per cent of its consumption; the market economies of Europe and Japan import more than 70 per cent of their requirements.

Some of the net importers have developed custom-smelters, in most of the cases they were installed before or during the 1930s; Belgium, Germany, the U.K. and the U.S.; in Japan they were developed in the last 20 years as it became an important consumer.

Net exporters, except Australia, Canada and South Africa, are marginal consumers; they concentrate most of the sources of primary copper but only a marginal part of the secondary; the latter is relatively small since its rate of production depends on the historical volume of consumption.

Figure 5.1

Simplified chart-flow of the international trade

The value of copper exports represents a small and fluctuating percentage of world trade i.e.: 1972, 1.1%; 1973, 1.4%; 1974, 1.2% (1). But copper export is the second most important product, after oil, when its value is compared with other primary commodities and the most important of all the metals.

#### 5.2.1 Structure of net exports and net imports

When the structure of net exports is considered the importance of the control of the source of supply and the homogeneous character of the product is stressed. It is ignored the relation between primary producers-custom-smelter and simplified the rival producer-consumer relations.

Concentration of net exports is relatively high (more than 80% in six countries) though it has experienced a small reduction in 1973-74 because other two countries became copper exporters.

(1) The value of copper exports has been estimated on the basis of unitary price of each category of product. Price differences are based on information published by the Banco Central de Chile: Boleton Mensual No.588, February 1977. Value of world export taken from International Monetary Fund, August 1976.

Table 5.10

Concentration of net copper exports by countries

(in percentage)

<u>Countries</u>	<u>1965</u>	<u>1970</u>	<u>1974</u>
Canada	12.9	14.8	16.8
Chile	23.4	23.8	23.2
Indonesia			4.2
Papua New Guinea			5.2
Peru	7.8	7.4	6.4
Philippines	2.7	5.7	6.0
Zaire	13.2	13.2	12.2
Zambia	30.1	24.2	18.5
Others	9.9	10.9	7.5
TOTAL	100.0	100.0	100.0

Source: based on WB of MS: World Metal Statistics

It is noted the significant market share reduction of the Zambians which will possibly continue falling in the future. Canada and Philippines were the only countries which improved their position.

Additional changes have already taken place in 1977-78: Peru has improved its position after starting production in Cuajone and Cerro Verde; Iran was to become a copper exporter and Mexico, a marginal producer, will also enter to this market. A new net exporter will be Panama in the 1980s.

Net imports concentration is also relatively high, more than 80% in six countries. Thus considering the structure of both markets, buyer and seller, they are formed by few participant countries.

Table 5.11

Concentration of net copper imports by countries

(in percentage)

<u>Countries</u>	<u>1964</u>	<u>1970</u>	<u>1974</u>
France	11.6	12.6	11.7
Germany	20.6	19.4	16.4
Italy	7.6	10.0	8.7
Japan	13.8	26.5	25.5
U.K.	23.1	15.2	12.3
U.S.	11.1	3.3	11.5
Others	12.2	13.0	13.9
TOTAL	100.0	100.0	100.0

Source: WB of MS: World Metal Statistics, several issues.

Copper imports are a small percentage of the value of total imports of the consumer countries; in 1974 they represented 2.5% of total German imports; 3.6% of the Japanese; 2.0% of the British and 1.8% of the French (1). These percentages became smaller when considered net copper imports since some of these countries buy it at a lower degree of elaboration and then export refined copper. Taking into account this situation the percentage are as follows: Germany 1.7; U.K. 1.8; and Japan 2.7 (2) (3).

#### 5.2.2 The copper exporting countries

The net copper exporting countries have significant differences in terms of degree of development, two of them are among the 12th richest countries in the world; Canada (rank 10th in 1974) and Australia (rank 12th). The other net exporters have an annual income per-capita below 1,000 dollars but there are still great disparities. Chile with nearly 1,000 and Zaire with about 100 dollars.

The same can be said with respect to the educational level at one extreme Canada and Chile with a degree of literacy greater than 90% and on the other side Zaire with 15% while all the other countries covering the intermediate positions. Other social indices present similar characteristics.

Except in Zambia, the contribution of mining and quarrying to the GNP fluctuated from 1 to 15 per cent, but it is noted that in the National Product Statistics mineral processing is included in manufacturing activities.

The labour force working in mining is also a relatively small proportion of the active population in all these countries, generally less than 5 per cent.

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- (1) These percentages must be considered rough estimates.
  - (2) Although copper prices were exceptionally high in 1974, an estimation for 1972 resulted in similar percentages, Germany 1.5%; Japan 3.7%; U.K. 1.9% and France 1.7%
  - (3) Japan exported a significant amount of refined copper in 1974 but this was a special situation as will be shown later.



Table 5.12

Some general characteristics of the net copper exporting countries

Countries	Population (millions)	Literacy (%)	National Income per Capita (US \$ 1974)	Export (a) % of world	Composition Exports 1974
Australia	13,3	95	5,460	1,3	Non ferrous metals 6%, agriculture products 24%.
Canada	22.5	95	5,672	4,0	Motor vehicles 23%, crude oil 16%, paper 7%.
Chile	10.4	92	896	0,3	Copper 67%, Nitrate 20%.
Indonesia	128.6	60	200	0.9	Oil 65%, timber 9%, rubber 6%.
Papua New Guinea	2.7	29	500	0.1	Copper 56%, Cocoa 9%, coffee 8%.
Peru	15.3	61	650	0,2	Copper 23%, Fish 13%
Philippines	41.5	83	314	0.3	Sugar 27%, Capra 22%, Copper 15%.
South Africa	24.9	57	1,150	1.0	
Zaire	24.2	15	126	0,1	Copper 94%
Zambia	4.8	47	400	0.2	Copper 62%, Cocoa 9%, Coffee 8%.

(a) Total export/World Export.

Source: UN: Annual Year Book, 1975

In all these countries, primary commodities exports represent a significant part of their exports, including Canada (55% in 1974) and Australia (60%).

However, the extent to which their export revenue depends on copper vary widely. In four of these countries copper represents most of their exports: Chile, PNG, Zaire and Zambia. In Peru over 20 per cent and it will become more important: in Philippines 15%. In all the others less than 5 per cent.

In four of the more dependent countries on copper exports the long term external debt has reached a significant level: the ratio debt-GNP is almost 1:2 in three of them and 1:1 in Zambia.

Table 5.13

Long term external debt, estimation for 1978

Countries	Long term external debt (million \$)	Income Per Capita (dollars)	Debt Per Capita (dollars)	$\frac{C}{B} \cdot 100$	Service external debt-export ratio %
	A	B	C	D	E
Chile	4,500	896	433	48.3	36.9
Peru	4,200	650	275	42.2	49.0
Zaire	1,300	126	52	41.7	45.0
Zambia	2,000	400	417	104.2	25.0

Sources: Column A: Metal Bulletin, February 24th, 1978, page 20.

Column C: UN Yearbook of National Accounts Statistics, 1976.  
International Tables.

Column E: Chile and Peru: Bank of London and South America  
Review, 1978, pages 380, 455, 460. For Zaire and  
Zambia estimations based on information in newspapers.

The services of the external debt-export ratio are possibly among the highest of the world and the information available suggests that this will not change at least in the next five years.

Among the several implications of this situation two are specially important for the scope of this study: the balance of payment pressures, taking into account only the external debt, make extraordinarily difficult to implement a policy based on long run objectives; the rate of interest applied to future earning must be very high. Second, most of the creditors are the major consuming countries, so the primary producers may be the target of economic pressures, if not retaliation, if they adopt a market action.

### 5.2.3 The patterns of trade

During the last fifteen years the composition of the copper traded in the international market had a significant change. Concentrates represented less than 10% per cent of the total volume of copper exports in the first half of the 1960s: they increased to 25% in 1970-75. Refined copper has reduced its position from about 65 to around 60 per cent; the relative trade importance of blister has fallen from 20-25 per cent in 1955-65 to about 15 - 20 per cent in 1971-75. The causes and implications of these changes will be discussed once other modifications of trade structure and patterns have been considered.

In order to determine the changes in the structure and patterns of the international copper trade the situations in 1965 and 1974 are compared in table 5.14. Modifications due to conjunctural or particular conditions of the industry in any of those years will be mentioned, in order to identify the most permanent trade inter-relations.

Table 5.14 is subdivided in two parts, part I is referred to the exports and part II to the imports. The copper exporting countries were classified into two groups, the net exporters and net importers; the latter are those countries whose exports are lower than their imports but re-export. Part one simultaneously provides information about the world market share each country has by type of product (columns A) and the composition of the exports of each country measured in terms of volume (columns B). Columns A must be read vertically and the columns B horizontally in each of the years considered. For example, in 1965 Canada exported 32% of concentrates and 10% of the refined copper (columns A 1965) and concentrates represented 30% of her copper exports and refined 69%.

In the same way the second part of the table supplies information about the world importance that each country has in each type of product (columns A) and the composition of their imports (columns B).



#### 5.2.3.1. International trade of concentrates

There are two main buyers of concentrates, Japan and Germany, both of them increased their importance as purchasers, Japan from 55 to nearly 78 per cent and Germany from 13 to 20 per cent of the total trade of this product. Gradually, this market has been approaching to a monopsony, in terms of the number of participant buyers countries.

On the supply side, concentration has tended to decrease both through reduction of the market share of the leading producers and the increase of the number of supplier countries.

The four leading seller countries supplied 80 and 74.5 per cent of concentrate exports in 1965 and 1974 respectively, but in the last year, among the leaders there were two new producers, Philippines and PNG. The number of sellers with more than 4% market share were 5 in the 1960s, increasing to 7 in the 1970s. It must be noted, that the two most significant entries into the copper export market in 1950-75 were made through selling concentrates.

Three countries exported only concentrates, all of them are underdeveloped nations, two of them are new copper producers. The three had 40% of the market share of their product.

The other countries also export blister and refined copper, but the importance of concentrates has increased in the volume of their total exports.

It is noted that developed countries have a relatively important selling market share in the market of concentrates, 35 per cent. Furthermore, while the Canadian exports of refined copper remained stagnant, those of concentrates considerably increased in the period.

Finally, Japan being the most important market for concentrates it is not surprising to see that the supplier areas geographically closer to that market have increased their importance.

#### 5.2.3.2. Blister exports and imports

Chile, Peru, South Africa and Zaire concentrated about 80% of the exports of blister in 1974. The most important centers of treatment of blister are: Belgium, Germany, the U.K. and the U.S.; these countries export part of it as refined.

Only two countries export most of their copper as blister, Peru and South Africa. Chile was the most important exporter of blister in the 1960s, but it has invested in refinery capacity and has also decided to compete in the market of concentrates. Zambia also had an important share in the market of blister but has become a net export of refined copper.

Belgium developed an important refinery industry to process the copper produced by its colony (the Belgium Congo) in the 1930s. Nowadays, about 50% of the Zairean output is treated in Belgium.

In 1974 the Zairean government announced as a goal that in 1980 the country would only export refined copper; it signed a contract with a Belgium company to build a refinery. This programme has been postponed due to financial difficulties.

The U.S. treated part of the Chilean production and most of the Peruvian output. In both countries this industry was developed by U.S. companies. Chile supplied most of the blister imported by the U.S.; after being treated part of this copper was re-exported to other consuming areas, mainly European markets. Chile increased its refinery capacity and the export of blister has fallen as a percentage of its copper exports. In Peru, most of the copper is produced by a company controlled by ASARCO, one of the largest copper processing companies in the U.S.; this company refined the copper output of Kennecott for more than 40 years, but in the 1950s this firm decided to build its own refineries; ASARCO began to develop copper mines in the U.S. and abroad partly to supply its refineries, and partly to use the accumulated expertise in this product. In 1975, the Peruvian government completed the investment in the 150,000 tons capacity refinery at Ilo and has planned to expand it to 300,000 tons: when this plan is implemented the total Peruvian output will be refined in this country.

Germany is the other important center of treatment of blister. Its sources of supply have varied in the last 30 years. In the 1950s and 1960s the most important sources of supply were Chile and Zambia, but as these countries integrated vertically, Germany obtained its blister from South Africa and Peru.

The importance of the U.K. as a processing center has drastically declined in the last 30 years. In the 1950s most of the copper processed in the U.K. had as origin Northern Rhodesia; Zambia increased vertical integration and the U.K. copper imports changed of composition, augmenting those of refined, but diversifying its sources of supply.

The vertical integration of the major exporting countries has affected to different extents the custom-smelters. In the U.S., the capacity of production has been used to refine domestic blister; the U.K. has opted to maintain the capacity of production which has tended to decrease as a proportion of consumption. Belgium and Germany are looking for alternative sources of supply.

However, it is noted that these countries have accumulated expertise, know-how which will be used at the first opportunity which may arise; their facilities have no alternative use and it is obvious that they will maintain them in use.

On the other hand, if the cost of capital is considered as a barrier to entry in the industry its magnitude is reduced through the existence of this capacity.

The copper exporting countries have untied their exports from one country and gained flexibility by integrating vertically, but they have not done anything to counteract some of the implications of their decision, as will be seen. Even more, attending to their behaviour in the last 6 years, one of the possibilities is that the progress on integration may well be undone in the next years, as will be discussed in Chapter 7.

#### 5.2.3.3 Refined copper trade

Only two countries increased refined copper as a proportion of their copper exports, Chile and Zambia. Australia and Canada decreased the degree of elaboration of their copper exports.

The most important exporters of refined copper in 1964 were Belgium, Chile, the U.S. and Zambia. Only the Chilean had improved their position in world copper exports.

In Japan the copper imported is mainly consumed domestically. It exported a significant amount of copper in 1974; that year there was a large accumulation of stocks of concentrates and refined as demand was declining; the Japanese started to sell their surplus of copper in the international market depressing the prices. This situation is analysed in detail in chapter 7.

In the 1970s copper trade with the CPE began to increase, however, the balance of trade has changed from one area to another; the net exports or imports have been marginal.

Except in Japan, refined imports increased as a proportion of the total copper imports; however, the Japanese were the most dynamic market in the capitalist countries, so the net effect tend to be negative from the point of view of the primary exporting countries.

#### 5.4 Vertical Integration

To determine the degree of vertical integration in the primary producing countries three indices are used: S/M; R/M; R/S where M, S, R are mine, blister and refined production, respectively in one year.

The index can vary from infinity to zero. The latter when the whole production of a country is sold as concentrates; the former in the case of a country that has no mine production but some smelter or refinery output.

Some of the limitations of such indices are:

- The use of output instead of capacity of production may produce different results because the installation may be used at different intensities in a given period. But, unfortunately there is no reliable information for mine production capacity.
- It is not possible to determine between which values of the index the copper industry of a country can be considered as vertically integrated. In an industrialised country primary smelter and refinery output are much larger than mine production because they also process secondary copper and in some cases process copper produced in other areas. In nations with vertically integrated copper industries the index tends to the unitary value. Despite the limitation of the indices, they give an idea about the level of integration of the industry and permit one to compare changes in the structure of the copper industry.

The results presented in table 5.15 reinforce the patterns defined in the analysis of the structure of the industry and international trade so they will be summarised briefly.

- a) There are two areas almost fully integrated vertically, the U.S. and the socialist countries. In the last four years Zambia passed to form part of this group.
- b) The aggregate indices for the net exporting countries reflect a reduction of the vertical integration at smelting and refining but an increasing proportion of the copper which is smelted is also refined by them.

As already noted, part of the new processing capacity is not reflected in the datas of production of 1974, but the aggregate result would not change too much, a process of vertical disintegration has taken place in the international copper market.



Table 5.15  
Vertical Integration Indices  
(Production thousands short tons)

Countries	Mine Production		Smelting		Refining		Smelter C Mine	1965		1974		Smelter D Mine
	1965 A	1974 B	1965 C	1974 D	1965 E	1974 F		Smelting C	Refining C	Smelting B	Refining D	
United States	1,356	1,597	1,520	1,562	2,153	2,147	1.12	1.42	1.58	0.98	1.37	1.34
Canada	510	905	422	568	433	615	0.83	1.03	0.85	0.63	1.08	0.68
Chile	645	994	615	798	318	592	0.95	0.52	0.49	0.80	0.74	0.60
Peru	199	246	175	198	41	43	0.88	0.23	0.21	0.80	0.22	0.17
Belgium	-	-	-	-	308	427	-	-	-	-	-	-
Germany FR	1	2	394	345	376	466	3.94	0.95	3.76	1.72	1.35	2.33
Japan	118	90	403	1,098	402	1,096	3.42	1.00	3.41	12.20	1.00	12.13
South Africa	67	197	60	163	18	97	0.90	0.30	0.27	0.82	0.60	0.49
Zaire	318	551	318	529	168	281	1.00	0.50	0.50	0.96	0.53	0.51
Zambia	767	769	767	782	574	735	1.00	0.75	0.75	1.02	0.94	0.96
Australia	96	264	82	216	104	176	0.85	1.27	1.08	0.82	0.81	0.67
Socialist Count.	867	1,817	900	1,844	1,211	-	1.04	1.35	1.40	1.01	1.35	1.38
Indonesia	70	71	-	-	-	-	0	0	0	0	0	0
Philippines	-	249	-	-	-	-	0	0	0	0	0	0
Papua New Guinea	-	203	-	-	-	-	0	0	0	0	0	0
Net Exporting Countries	2,672	4,449	2,739	3,254	1,656	2,539	0.91	0.68	0.62	0.73	0.78	0.57

- c) Chile, South Africa and Zambia were the countries which had a backward integration but at different degrees. Zambia is a fully integrated producer from mine to refining: Chile increased the proportion of copper refined but reduced the percentage of copper smelted.
- d) In Peru and Zaire the situation did not change in the period, but it improved in Peru after 1974.
- e) Indonesia, Papua New Guinea and Philippines did not treat their copper production. In two of these countries copper production started not long ago.
- f) Australia and Canada have experienced a process of vertical desintegration, increasing the proportion of unprocessed copper.

Vertical integration is one of the areas of interest coincidence among the net exporting countries and may be one of the basis to formulate a common policy.

It would seem that at least smelting is a process the industrialised economies will not continue developing as custom-smelters in their markets due to cost considerations (environmental restrictions and transport expenses). These variables do not affect refineries.

With respect to smelting, it must be stated that it is perfectly possible that private companies start to build up smelters facilities in developing countries other than primary producers. The companies reduce or spread risk, increase their bargaining power and may obtain considerable tributary concessions and other benefits which may well compensate for the greater cost of transport.

There are grounds to expect this development: the intense and destructive competition in the copper market and the intense competition among UDC to obtain foreign capital to develop new deposits. Situations which will be analysed in chapter 7.

#### 1.5 The World Copper Systems

Attending to the origin of primary copper, the role of copper imports and/or exports, and to the characteristic of the operation of the market, the world copper industry can be subdivided into three systems: the centrally planned economies, the U.S., and the international market.

Each subsystem has its own characteristics which make it different from the others, but each system interacts in the others. The decisions

adopted in one system may have considerable influence on the others; disruptions of production due to strikes, technical problems or other reasons, may shift the demand of one system into the others affecting availability and prices; conversely a situation of surplus in one system will also affect the others. However, each system operates on a different basis:

a) The centrally planned economies are self sufficient, their production is vertically integrated and consumption has been quite dynamic in the last 30 years.

Production is highly concentrated by state owned companies and the most important decisions are made by centrally planned organisations. The trade within the system is based on long term contracts. However, the prices of copper in the transactions with the market economies are based on the London Metal Exchange.

In the last 25 years, the most important copper producer has been the USSR which had supplied most of the requirements of the members of the COMECON. In the 1970s Poland has been becoming an increasingly important producer. Mongolia will also start production, it has an agreement with the USSR to develop an important deposit.

Copper trade with the market economies has been increasing since the second half of the 1960s, the balance of the trade has changed from one year to the other from net exports to net imports, but has always been marginal.

It is most likely that the members of COMECON will continue being self sufficient in the near future. Their exports and imports will also increase and the net effect on the market economies may change the market trend in some years, either increasing or reducing the price of copper. In the case of China, for political reasons, they will import from the international market, becoming a growingly important market for the net exporting nations.

b) The U.S. is also a vertically integrated producer: controls an important proportion of the world copper reserves, it has been the leading producer and consumer since the last decades of last century, but its importance has been declining gradually and persistently since the 1930s as new centers of production and consumption have emerged. Since the Second World War the U.S. has become a net importer of copper but foreign sources only supplied about 10% of total consumption in 1970-76. It can be expected

however that the importance of copper imports will increase in the future; according to the U.S. Bureau of Mines the average yield from U.S. copper ores declined from 0.7 per cent to 0.49 per cent between 1965 and 1974 (1); the grade of new deposits is even lower so the cost tends to be higher than new deposits in the international market. This situation is paired with relatively drastic anti-contamination regulations which also operate in the same direction.

The U.S. government raw material policy has been to avoid dependence on foreign resources considered strategic for economic, political and military reasons.

When this is not possible for lack of resources, strategic stockpile have been formed, equivalent to 10 to 36 months consumption depending on the raw material.

In the case of copper, stockpiling, development of internal sources of supply was adopted in the 1950s, but simultaneously it was decided to reduce concentration of production in the three largest copper companies, so the policy was implemented supporting marginal producers and new entrants in copper mining (2). Subsidies, long term buying contracts which included protective floor prices, were introduced. In the 1960s, this policy was partially abandoned and the development of overseas copper deposits by U.S. companies was supported. In 1973 it was decided to liquidate the stockpiles. However, the government remained reluctant to rely on increasing supply from foreign sources of supply: no definite policy has been defined so far; strategic stockpiles goals have been reintroduced but no purchase has been made yet; support of seabed mining has been given as a long run solution. However, the anti-contamination legislation implies a significant financial commitment to the copper companies. In addition the grade of the U.S. undeveloped copper deposits is lower than those of the international market. Thus if the government decides to promote internal production some type of internal support must be given to domestic suppliers; the other possibility is that the government accepts becoming more dependent on copper imports, supporting a programme for overseas exploration and development, implementing the purchases of stockpiles.

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(1) W.R. Killensworth: Copper Review. Mining Congress Journal, November, 1976, pages 31-35.

(2) N.N. Reddy: U.S. Copper Stockpile Policy. University of Missouri Business and Government Review, 1970, September/October, pages 28-32.

The last option has a high probability of being adopted, because a programme of self sufficiency determined exploitation of more uncompetitive resources; especially in a context in which energy is not any more a cheap resource, and that tariff or other barriers to trade are unlikely to be adopted (1). However, a more specific course of action will probably be adopted when the situation of oversupply prevailing in the copper industry starts to be overcome.

Concentration of production has been relatively high, though decreasing since the 1950s. In 1975 the 10 largest producers controlled 90% of mining, smelting and refining capacity (2) and possibly about 60% of the semi-manufacturing capacity.

Until early in 1978, the copper companies fixed the price at which producers sold the metal; the mechanism to co-ordinate their decisions was price leadership. The prices were more stable than the LME quotations (3) in 1964-78. The U.S. producer's prices were lower than those of the LME (1964-70 and 1973-74) while in periods of surplus the U.S. producer's prices were higher.

The producer's price could operate on the basis of five factors: i) high concentration of domestic primary production in few firms which also control a significant proportion of secondary processing and an important part of new scrap generation. ii) Relatively high barriers to entry: the largest companies control a significant part of the richest potential sources of supply; high scale of production at the three stages of production and high investment per unit of output. iii) Producer's discipline developed in the market of an homogeneous product after several years of operating together. iv) High degree of vertical integration at the three stages of production and control of a significant proportion of the market at semi-fabricating. v) The government economic policies gave the U.S. producers an additional inducement to co-operate since the losses which may have been incurred in periods of slump could not have been recovered in periods of boom due to direct or indirect intervention of the government against companies which threatened its policies of economic stabilisation. For instance, sales from strategic stockpiling were an

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- (1) The President of the U.S. has recently rejected a recommendation of the U.S. International Trade Commission: to grant a copper import quota.
- (2) Metal Bulletin Monthly: Copper, Aspects of Integration. Metal Bulletin Monthly, September 1976, pages 13, 15, and 17.
- (3) See J.E. Tilton: Impact of Market Instability for Mineral Materials. page 376. The World Economy, Vol.I, No.4, October 1974, pages 369-383.

important deterrent against price increases; in 1950-73, the U.S. President directly intervined at least once to induce a reduction of price; in 1972-74 the price of copper was under government control.

c) The third system is mainly composed by Japan and the European countries with market economies. All of them are highly dependent on primary copper supplied from abroad: in 1975, their own internal primary and secondary sources supplies about 18% of the consumption of refined copper.

It is unlikely that their dependence on foreign copper supply will decrease in the future because their known reserves are pretty small in relation to consumption and these areas have been intensively explored. Although the system includes a large number of countries, consumption is highly concentrated in only five of them, more than 80% of the system.

The price of copper imports is fixed on the basis of the LME since 1966.

The major supplier countries are a group of net exporting countries, relatively heterogeneous in degree of development. Copper mining production is highly concentrated in five of them, but a significant part of the processing facilities are located in the consuming countries.

#### 5.6 The Structure of the Copper Industry by Companies

In the 1960s substantial changes of structure of the copper industry took place. Three countries nationalised their industries, directly affecting the leading producers of the 1950s and indirectly causing a large number of reactions which also affected the structure of the market. Another factor operating in the same direction was the change in the geographical structure of consumption.

The objectives of this part are basically three, though the last one has not entirely been accomplished:

a) To determine the structure of the industry and to assess the magnitude of the changes. The period was subdivided in two: 1950-64 and 1965-74. The cause of the division was the fact that two different patterns of behaviour have existed in the copper industry and it is intended to look for those structural changes which may explain such behaviours. As the period of drastic changes of structure lasted about 10 years, 1974 is considered as a basis of comparison. What can be called the period of transition and adjustment and the process of nationalisation itself is studied in chapter 6.

b) The determination of the corporate and company inter-relations. Most of the leading copper companies are relatively diversified concerns. For this reason two types of inter-relations were established. Corporate inter-relations, that is, those prevailing among the parent companies and financial or economic groups and/or ownership connections among the parent companies. Company inter-relations are those which take place within the copper industry.

c) An effort was made to determine the structure of the semi-manufacturing copper industry in some of the major consuming countries; unfortunately, there are no other studies on this subject and information is poor, so the analysis had to be restricted geographically and to the 1970s.

The criterion used to determine the structure of the industry was majority ownership. For example in 1974 ASARCO controlled Southern Peru, Northern Peru and Mount Isa outside the U.S. The production of these firms was considered as output of ASARCO. This criterion has the limitation that some companies have important minority control in some enterprises as in the case of Anglo American Company which holds 49% of the Nchanga Consolidated Mines but the balance is controlled by Mindeco, so the whole production was allocated to the Zambian government.

However, there are few situations of this type. Moreover, the limitation is overcome through the analysis of the corporate and company inter-connections and additional information about the companies, permitting a better evaluation of their position in the market.

#### Limitations and Problems

The analysis of the corporate inter-connections was limited to those considered more relevant to the copper industry. Other forms of corporate inter-connections (such as direct or indirect interlocking directorate or contractual relations) were excluded, but their inclusion would have reinforced the most general conclusion which can be drawn from this analysis.

The corporations also produce other minerals and participate in other markets in which they may develop company inter-relations which, in turn, may be important to understand the behaviour of the copper producers, but they are not considered in this study.

One of the major problems is that this study covers a relatively long period and corporate and company inter-relations are relatively dynamic in the long run. The studies on this subject are few and their methodological approaches different, however some general conclusions can be drawn.

Another important consideration is that significant changes have been taking place in the corporate inter-relations in the second half of the 1970s. Some of the leading private corporations have merged with other companies or an important proportion of the shares of some producers have been bought by other corporations. This process is fairly recent and has not ended yet, so that only general information can be given.

#### 5.6.1 The structure of the copper industry by companies in 1950-64

Prior to 1964, 60% of the copper reserved available to the market economies were located in Latin America and the United States and all of them were controlled by U.S. companies. Nearly 30% were located in Northern Rhodesia, Canada and Australia, those in the British Colony were entirely controlled by one British-South African company while the Canadian reserves were controlled basically by two enterprises; in Australia most of the reserves were controlled by Mount Isa, a subsidiary of ASARCO. Finally, 7% of the reserves were located in the Belgian Congo, being controlled by a single Belgian Company (1).

It is difficult to find out information on the control of the copper reserves by companies; and there is evidence that the control was not related to their market share. A rough estimation can be given for the early 1960s: Anaconda controlled 25% (2), and Kennecott 15%, Anglo American concentrated about 20%; Union Miniere 7% and ASARCO probably 10%. That is five companies controlled about threequarters of the market economies reserves, making difficult the entry of new producers in copper mining and to a lesser extent in smelting.

A few companies controlled most of the copper output of the market economies (see table 5.16).

In the early 1950s, the three leading companies were Anaconda, Kennecott and Phelps Dodge which mainly supplied the U.S. market. Two of these companies experienced reduction of their position partly due to the low rate of growth of their principal market, partly to the fact that the U.S. government implemented a programme of expansion of domestic production but based on producers other than the leading companies (see table 5.16).

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- (1) R.C.P. Brookhouse: World Copper Prospects. Banker Trust Company. London, January 1973, page 5.
- (2) T. O'Henton states that Anaconda controlled 40% of the market economies in 1960, but it would seem an exaggeration. T. O'Henton: The Perilous Prosperity of Anaconda. Fortune, May 1966.



Production concentration declined at the level of the 4th, 6th and 8th largest producers, though the 10 most important controlled more than 70% of the output.

In the second half of the 1950s ASARCO entered into copper mining though it was already an important custom-smelter in the U.S. (1).

It should be noted that the leading companies controlled the production of the U.S. and the international market, making easier the co-ordination of the decisions in the two systems.

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(1) ASARCO was already exploiting a small copper deposit in Australia in 1951, but its importance was marginal.

Table 5.16

Market controlled by leading copper producers in 1951, 1960, 1964

(as a percentage of capitalist mine output)

Companies	1951	1960	1964			
			in the U.S.	ex the U.S.	Total	Accumulate
Anaconda a)	11.1	11.9	3.2	10.1	13.3	13.3
Kennecott b)	23.5	14.4	8.5	4.3	12.8	26.1
Anglo American c)	8.5	10.9		10.0	10.0	36.1
Amax d)	7.1	5.5		7.0	7.0	43.1
Union Miniere de Haut Katanga	8.2	8.3		7.0	7.0	50.1
Phelps Dodge e)	9.7	5.9	6.3		6.3	56.4
ASARCO f)	*	5.6	1.8	4.5	6.3	62.7
Newmont g)	**	3.1	2.5	1.9	4.4	67.1
Noranda h)	1.0	1.5		3.8	3.8	70.9
International Nickel	4.8	3.9		3.2	3.2	74.1
TOTAL	73.9	71.0	22.3	51.8	74.1	

Mine Production  
(thousand short tons)

1951	1960	1964
2.566	3.972	4.335

\* It operated a small mine in Australia.

\*\* Information not available

- a) In 1951 and 1960 it includes mine production of Anaconda in the U.S., Andes Copper Mining (Chile) and Chile Exploration Co. (Chile). In 1964 the already mentioned companies plus Cananea Consolidate Copper Co. (Mexico) and Santiago Mining Co.
- b) It includes mine production of Kennecott in the U.S. and Braden Copper Company (Chile).
- c) Anglo American Corporation: it includes Rhokana, Nchanga, (Northern Rhodesia), Hudson Bay Mining Co., in Canada and Bancroft in 1960 and 1964 (it started production in 1957).
- d) In 1951 and 1960 it includes Mfulira Copper Mines and Roan Antelope Copper in Northern Rhodesia. In 1964, it includes Chibuluma, Luanshya, Mfulira (Northern Rhodesia).
- e) It does not only include production from owned mines but also concentrates produced from purchased ores.
- f) It includes Southern Peru Copper Co. (Peru) and Mount Isa Mines (Australia). In 1964 it also includes mine production in the U.S.
- g) It includes Magma Copper in the U.S.: O'okiep in South Africa in 1960; in 1964, the already mentioned companies plus Tsumeb of South West Africa and Sherrit Gordon of Canada.
- h) In 1951, only Noranda and Gaspe Mines in 1960.

Sources: The table was built by the author based on: McMahon: Copper Material Survey for 1950 and 1960. American Bureau of Metal Statistics for 1964. W.R. Skinner: Mining Year Book, several issues. Some issues of the "Who owns Whom", Northern American Edition, U.K. Edition and Continental Edition.

One report on Anaconda in the mid 1960s when considering the high concentration of the industry quoted the comment of the President of this company "I can reach every major producer in the world right now with a telex message, so you can see how easy it is for this industry to stabilise prices" (1).

It is noted that the leading companies produced most of their output in areas other than their countries of origin: almost the total output of Anglo American and AMAX had its origin in Northern Rhodesia; in the case of Kennecott, 33% came from its Chilean Subsidiary, Braden Copper Company, finally Anaconda 70% of its output had as origin the two Chilean subsidiaries Andes Copper Mining and Chile Exploration Company.

It was not possible to measure the market share of the leading companies at smelting and refining on a company by company basis; aggregate information suggests that concentration was even greater than in mining (see table 5.17).

Table 5.17

Concentration of refinery production in the market economies  
(as a percentage of capitalist production)

	1955	1960	1965	1968 (a)
4 largest companies	53.8	52.8	47.0	51.0
8 largest companies	79.9	81.9	78.5	79.5

(a) In 1968 some changes in the ownership of some companies had already taken place, but it seems they were not considered in the table. The Chilean government bought 51% of the assets of El Teniente in 1967; in the Peoples' Republic of the Congo the copper mines were nationalised on 1st January 1967.

Source: Based on Charles River Associates Inc. The Copper Industry. Boston 1970.

Most of the leading companies were highly integrated from mine to refining. (see table 5.18). The custom-smelters had a relatively important share but they were far less important than nowadays.

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(1) T. O'Henton: The Perilous Prosperity of Anaconda. Fortune, May 1966.

Table 5.18

Vertical integration of the copper producers in 1966

	Integrated Primary Producers (a)	Custom Refiners	Primary Producers	Miners	Total
Number of companies	30	14	14	270	-
% of mine production	73.3	0	8.3	18.40	100
% of smelting capacity	86.8	3.8	9.4	0	100
% of refining capacity	83.3	16.7	0	0	100

Source: Charles River Associates Inc. Ob.cit.

- (a) Sociedad Espanola de Construcciones Electromecanicas and its subsidiary, Industrias Reunidas Minero Metalurgicas are taken to be a custom refiner. Empresa Nacional de Minería (ENAMI) and Paipote, both of them owned by the Chilean government are also considered to be a single custom-smelter. Metallurgic Hoboken was considered as part of an integrated producer.

#### 5.6.1.1. Inter-relations among the copper companies

In the 1960s the copper companies were inter-related by common ownership and joint membership in the exploitations of some mines, directly and indirectly interlocking directorates.

Hardy (1) analysed this aspect, classifying the copper producers in 21 groups, according to their sale agent. The results of this study can be briefly summarised as follows:

Type of interconnection	Number of inter-relations among the copper producers
Ownership (a)	48
Joint membership (b)	24
Direct Interlocking (c)	11
Indirect Interlocking (d)	167

- a) Ownership interconnection exists when any of the following conditions prevail: A owns all or part of B; B owns all of part of A; C owns all of or part of A and B,
- b) Joint membership was defined by Hardy as a special case, when the flow of copper of 2 or more vertically integrated groups were moving through a single processing unit.

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(1) N. Hardy: Vertical and Horizontal Structures in the Copper Industry. Ph.D. Thesis, Michigan State University, 1969.

- c) Direct interlocking directorates when A and B share one or more common directorates.
- d) Indirect interlocking directorates exist between A and B when both of them have a director in firm C.

Hardy's study permits one to state that most of the copper producers were inter-connected. This suggests that producer market interdependence was reinforced by companies inter-connections. These co-operative relations were strengthened, at least in some cases, by what has been called here corporate interconnections.

#### 5.6.2. The structure of the copper industry by companies in 1974

The leading producers of the early 1960s experienced an important erosion of their market share, as can be seen in Table 5.19 AMAX, Anaconda, Anglo American and Kennecott concentrated 43% of the market economies output in 1964 and only 12% ten years later.

The two dominant copper producers of the 1960s were confined to the U.S. domestic market. The nationalisations of the Chilean subsidiaries of Anaconda reduced the output of this company by about 70%: and by 33% in the case of Kennecott. In Zambia the partial nationalisations considerably reduced the market shares of Anglo American and AMAX but in 1974, both companies still maintained a position of influence through minority ownership and through management, technical and marketing contracts. The copper mining company owned by Union Miniere in Zaire was totally nationalised; but in 1974 Union had still considerable influence on the Zairean company through technical and management contracts, marketing of the copper and through processing about 50% of the Zaireans output.

The new leading producers are totally (Chile and Zaire) or partially owned (Zambia) by these governments, controlling 33% of the market economies output. In the early 1960s the state owned companies produced no more than 3% of the output of the market economies.

It is noted that in 1974, except ASARCO, none of the leading suppliers of the international market had an important position in the U.S., making more difficult the co-ordination of the decisions of the two markets.

As a result of the nationalisations in Chile, Zaire and Zambia the leading copper producers of the 1960s lost their control of the copper reserves in these countries. These countries and the Peruvian government changed their policies on mineral concessions and most of the undeveloped copper reserves reverted to the state. So the leading private copper

Table 5.19

Structure by Companies of Mining, Smelting and refining in the market economies (a)  
(as percentage of output or capacity of production of the capitalist countries)

COMPANIES	Mine Production 1974			Smelting Capacity 1973			Refining Capacity 1975		
	Im US	Ex US	Total	Im US	Ex US	Total	Im US	Ex US	Total
Amax (US)	1.1		1.1	2.0		2.0	3.8		3.8
Anaconda	3.6		3.6	3.1		3.1	2.8		2.8
Anglo American Co.		1.3	1.3		0.8	0.8		1.9	10.0
ASARCO (US)	1.2	5.3	6.5	5.4	4.3	9.7	8.1	1.9	
Atlas Consolidated (Phil)		1.5	1.5						
Boliden (Sweden)		1.2	1.2		0.9	0.9		0.7	0.7
CODELCO (Chile) and ENAMI		14.1	14.1		10.6	10.6		7.3	7.3
Cyprus (US)	1.6		1.6						
Duval Co. (US)	2.0		2.0						
Freeport Indonesia		1.1	1.1						
International Nickel (Canada)		2.9	2.9		2.5	2.5		2.3	2.3
Inspiration Co. (US)	0.8		0.8	2.2		2.2	0.9		0.9
IMI Refiners (U.K.)								0.8	0.8
BICC Metals Ltd (UK)								2.0	2.0
Japanese Producers (b):									
Dowa Mining				0.8		0.8		0.7	0.7
Furukawa Electric Co		1.8	1.8	0.5		0.5		1.0	1.0
Mitsubishi				7.2		7.2		4.8	4.8
Mitsui Mining and Smelting				2.3		2.3		1.6	1.6
Nippon Mining Co. Ltd.				4.5		4.5		4.5	4.5
Sumitono Metal Mining Co				2.0		2.0		2.2	2.2

Metalgesselschaft														
Kennecott	6,1		6,1		1.8	1.8		3.3	3.3					
Metallurgie Hoboken					8.2	8.2		6.2	6.2					
Mexican Government		1,1	1,1		0.8	0.8		8.1	8.1					
Newmon Co,	2,2	1,9	4,1	2,5	1.6	1.6		3.5	3.5					
Noranda		2,5	2,5		1.0	3.5	2,2		2.2					
Placer Development Co,		1,5	1,5		4.9	4.9		5.2	5.2					
Phelps Dodge	4,2		4,2	6,4		6.4	5,9		5.9					
Rio Tinto Zinc		5,9	5,9		2.8	2.8		1.2	1.2					
Otokumpe Oy (Finland)		0,7	0,7		0.7	0.7		0.6	0.6					
Texugulf (Canada)		0,9	0,9											
Hutenwerke Kayser					0.8	0.8		0.9	0.9					
Sociedad Espanola de Construcciones					0.2	0.2		0.7	0.7					
Electrolitic Ref & Sm Co, (Aust)					0.1	0.1		0.6	0.6					
Cities Service Co, (US)	0,5		0,5											
Zairean Government		7,5	7,5		5.8	5.8		2.4	2.4					
Zambian Government		11,4	11,4		9.1	9.1		7.3	7.3					
Southwire Copper Co,							0.8		0.8					
	23,3	62,6	85,9	21,6	74,2	95,8	24,5	69,8	94,3					

Note: Mine production considered as a base to determine the percentages 6640 thousand short tonnes : smelter capacity 7191 metric tonnes; refinery capacity 8500 thousand metric tonnes.

The table includes the companies which produced or had a capacity of production larger than 50,000 tonnes in any of the three processes of production, except when the copper producer was owned by one large company.

a) The dates on capacity of production at smelting and refining are based on the dates published by the American Bureau of Metal Statistics. The total may result in an under estimation of the total capacity, but there is no better public information.

b) It does not include the production of SODIMIZA. Mamut started production in 1975.

producers of the early 1960s not only lost their position as mining producers but also as holders of most of the copper reserves of these areas. Other private companies had become interested in developing some of those deposits, in some cases companies with relatively small market share and in other cases firms without previous interest in copper mining. It should be noted that the country of origin of some of these companies are nations which had not access to the areas with rich copper deposits previously.

Concentration has decreased when measured for all the companies supplying the market economies. When it is measured for the companies supplying the international markets the results might be misleading; in table 5.20 two different basis to measure concentration were used; it was maintained the output of the market economies as one of the basis: the indices show an increase of concentration in the period. This is due to the fact that in 1964 the Chilean and Zambian producers were owned by two different companies, while in 1974 they were majority owned by the governments. However, if the basis is changed and the output of the market economies excluding that of the U.S. is considered the results reverse. This is due to the fact that in 1964 the U.S. output represented 34.1% of the production of the market economies while in 1974 it was only 23 per cent.

Table 5.20

Concentration of production in mining in 1964 and 1974

(in percentage of the market economies production in A and B and market economies excluding the U.S. in C)

Number of largest companies	Market Economies (A)		Market Economies outside the U.S. (B)		Market Economies excluding the U.S. (C)	
	1964	1974	1964	1974	1964	1974
	4	43.1	39.5	34.9	38.7	51.8
8	67.1	59.6	49.7	51.3	75.4	67.1
9	70.9	63.5	51.8	53.1	78.6	69.5
10	74.1	66.1	n/a	54.6	n/a	71.7
20	n/a	81.7	n/a	61.7	n/a	80.7

In the international market two companies improved their market position, ASARCO and Rio Tinto Zinc. The latter only owned a small copper mine in Spain in the early 1950s but in the 1960s invested in Canada and in a relatively important copper mine in a territory under the administration of Australia, nowadays part of Papua New Guinea. Rio Tinto Zinc is probably the greatest supplying company of the Japanese.



#### 5.6.2.1 New Entries. The custom-smelters

During this period several entries took place in copper mining most of the new entrants are marginal producers each of them controlling less than 2% of the market economies' production. The most significant were: a) the entry of the Japanese into copper mining overseas but their production is too small in relation to their processing capacity; b) Freeport Indonesia; c) Placer Development (which has connections with Noranda); and d) several small mining producers in Canada. Most of these new companies only produce concentrates supplying mainly the Japanese market. These entrants, considered as a group, do not control more than 10% of the market economies' output.

A second type of entry was more important, namely that which took place through the transfer of assets from the private to the government owned companies. In this case the result was that the market became more competitive for several confluent reasons, only two of them will be considered here, the others in chapters 6 and 7. Firstly, nationalisation reduced concentration and so producer inter-dependence: secondly, the change affected the leading producers so the mechanism of market co-ordination whose operation is basically based on previous experience, which the new leading suppliers of the international market lacked.

At processing, the custom-smelters considerably increased their market share in 1965-75. In 1965 they concentrated about 16% of the market economies production, in 1973 they had increased their importance to 41%. This result was obtained by comparing tables 5.17 and 5.18; the former is based on a different publication so it is possible that differences on the criteria of classification of the companies influence the result but not to the extent of producing an important modification.

#### 5.6.2.2 The corporate structure of the industry

This part deals with some of the structural characteristics of the private companies involved in copper production: their connections with financial organisations, the ownership relations among the parents companies, their association in the copper industry through joint ventures, the degree of control of the semi-manufacturing industry and their degree of diversification.

The importance of this analysis is two-fold: on the one side it gives an idea of the strength of these companies, specially on accumulation of capital; secondly, these companies are competing for access to copper

resources. This competition may be relatively intense and will develop in conditions of great uncertainty.

At least 15 of the corporations participating in copper mining and/or processing were in the Fortune list of the 500 largest producers either in the U.S. or outside the U.S. In some of them this may be due to the importance of products other than copper, but in most of the cases copper made a significant contribution to sales.

The structure of the corporations had not remained static in the last 25 years or so. Moreover, relatively dynamic changes started to occur in 1975 when a process of mergers, takeovers and other arrangements began. This process is still in development so it is not possible to evaluate it yet.

There are several studies on the financial structure of the American industry; they provide a clear picture of the situation of the copper companies. With only one exception (1) the classification of the copper companies into economic groups is the same. To give an idea about the changes in the corporate inter-connections the result of two studies are presented, one refers to the early 1950s, the other to the last 1960s.

Cecena (2) classified Anaconda as controlled by the First National City Bank, although the Morgan Guarantee Trust had participation in this company. Chevalier (3) states that the Rockefeller group exercises minority control of Anaconda being under the influence of this group but the Morgan Guarantee was still linked to this company. In 1975, the CITICORP and the First National Finance Co. had one member each in the Board of Directors of Anaconda and J.P. Morgan and Co. another. In 1978, the situation drastically changed because Anaconda became a wholly owned subsidiary of Atlantic Richfield, an oil producing company (4). The merger of Anaconda was a competitive operation, another two companies were also interested in absorbing it (5).

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- (1) The exception is S. Menshikow: Millionaires and Managers. Progress Publishers.
  - (2) C. Cecena: El capital Monopolista y la Economia de Mexico. Cuadernos Americanos, 1963.
  - (3) J.M. Chevalier: Le Structure Financiere de l'Industrie Americaine. Cujar Edition.
  - (4) In the 1950s Atlantic Richfield diversified into petrochemicals, ammonia and plasticizers and in the 1960s into nuclear fuels.
  - (5) The other two companies were Crane Co. and Tenneco Inc. Crane, the largest producers of valves in the U.S., was forced to sell the 27 per cent of the shares of Anaconda by the FTC. New York Times, 1978: March 19, 47-2; April 2, 33-2; June 17, 61-2.

Kennecott and ASARCO were companies controlled by the Morgan Guarantee Trust, but the First National City Bank had participation in both of them, according to Cecena. For Chevalier the Morgan group exercises minority control in ASARCO and influence on Kennecott: the First National City Bank had a Director in both companies.

These two companies were formerly presented as closely related not only by the influence that the Guggenheim family had on both of them, in spite of the low percentage of shares they held, but also because until 1959 ASARCO treated an important part of the copper produced by Kennecott (1). In 1975, the interlocked directorate between ASARCO, and the FNCB and/or Morgan Guaranty Trust referred by Chevalier did not exist but persisted in the case of Kennecott (2).

However the situation of these two companies has also changed lately.

Curtiss Wright bought 9.9% of Kennecott's (3) shares, according to The Economist, between November 1977 and March 1978 (4). Despite the opposition of the administration of Kennecott, Curtiss Wright tried to obtain the control of that firm in 1978 (5). Curtiss Wright is 28%

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- (1) Chevalier suggests that the criteria to identify the inter-relations in the economic groups cannot be uniformed because of their complexity. In the case of these three copper companies they had interlocking directorates with both groups the first National City Bank and Morgan Guarantee Trust. The inter-connection of the companies with the groups was given by ownership inter-connections, the character of the interlocked directorates and administration of the pension funds, apart from other inter-relations. P.C. Dooley in the Interlocking Directorate (American Economic Review Vol.59, June 1969) states that today it is not possible to separate these groups and he calls them the New York groups; but Dooley identified the economic groups by the number of times their members were interlocked together. The study of Chevalier is more complete and rigorous from a methodological point of view.
  - (2) On the basis of The Financial Times International Business Year Book (Editions 1975 and 1976) could be determined that the CITICORP had two directorates in Kennecott and J.P. Morgan and Co. Inc., one, the President of the Financial Organisation.
  - (3) Early in 1977, Arab oil interests tried to take over Kennecott.
  - (4) The Economist, April 1-7 1978, and the Times May 4, 21a, 1978.
  - (5) The New York Times, 1978: May, IV, 1-2 and 1-4; May 2, 1-1 and 51-2; May 3, 1-2; May 4, IV, 1-5; May 7, 111, 15:1; May 11, IV, 9-1.

owned by Teledyne (1) a California conglomerate, involved in the engineering industry. Curtiss Wright is an aircraft parts maker from New Jersey. In the end, Curtiss Wright could only obtain a minority position on the Board of Directors (2).

In 1977, the possible merger of ASARCO with one of the largest oil companies was reported (3) but no definite steps were taken on this direction. In 1978, Bendix began to buy shares of ASARCO, controlling 17% by April (4) and about 20% by June (5). Bendix has announced that it will not seek more than 21% of ASARCO. Obviously, it is not possible to rely on these public statements during a process of taking over. It would seem that further changes will take place in ASARCO, though it is not possible to determine the direction.

Bendix is a supplier of the automotive and aviation industry but it is also involved in space and scientific instruments and in the construction of missiles (6). It has no interests in mining or metal processing apart from its stake in ASARCO.

Cecena presents Amax as controlled by the family of the founders and Phelps Dodge as an independent producer but under the influence of the Morgan and First National City Bank groups. Chevalier classifies both companies among those typical cases where an important influence of the families of the founders still exists; he also adds that Phelps Dodge is under minority control of the Massachusetts Investors Trust (MIT) group. The MIT owns 4.2% of Newmont Mining Company and 2.5% of Phelps Dodge; Newmont itself controls a further 2.5% of Phelps Dodge. MIT and Newmont are represented in the Executive Committee of Phelps Dodge by two members.

The Anglo American Co., through its subsidiary Selection Trust, is one of the largest shareholders of AMAX, 11.6% (7). This corporate relation is reinforced by historical links in the copper industry. Amax was the

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- (1) The New York Times April 3, 111, 15-1, 1978.
  - (2) The competition for the control of this company can be followed through the New York Times issues of January to June 1978.
  - (3) The New York Times April 3, 111, 15-1, 1977.
  - (4) The New York Times April 14 1978, IV: 4-3, and May 16, 30-2.
  - (5) The New York Times June 23, 15-2, 1978.
  - (6) The Financial Times International Business Yearbook, 1977/78.
  - (7) Jane's Major Companies of Europe, 1976.

only company with majority U.S. capital which had access to the Northern Rhodesian copper deposits which were monopolised by the Charter Consolidated. On the other hand in most of the copper mining activities outside the U.S. AMAX is associated with the Anglo American group. Phelps Dodge has also 5.0% participation in AMAX (1).

In 1975, the Standard Oil of California bought 20% of the shares of Amax (2). The oil company first announced that it planned to buy periodically shares of Amax to maintain its stake (3): in 1978 it changed its policy and was trying to acquire full control of Amax, in spite of the opposition of the administration of the latter (4).

It should be noted that for three years there was a project of merger between Amax and Copper Range (5). The latter being a small but integrated U.S. copper producer. The U.S. District Court did not authorise the merger but Amax could maintain its 20% stake in Copper Range (6).

The Anglo American group is a holding and finance group to handle the technical and managerial activities of a large number of companies involved in mining, manufacture, commerce and investment. This holding includes about 300 companies of which nearly 200 are administered within the group (7); in many cases, Anglo American owns less than 50% of the shares but the companies are linked to the corporation through management and the provision of technical and administrative services.

Three South Africans control more than 33% of the Anglo American's shares: another 22% are also held by South Africans, 44% of the shares are held in European countries (8). The Board of Directors consists of 14 South African and 8 British nationals.

This corporation controls about 40% of the diamond world production: 31% of the market economies gold output and 9% of the uranium production.

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- (1) Villarejo: Stock Ownership and the Control of Corporations.
  - (2) The New York Times, May 31, 33-1; June 19, 59-4: 1975.
  - (3) The New York Times, March 30 1975, IV: 33-1; June 19, 59-4.
  - (4) The Economist, September 16-22, page 83 and page 118.
  - (5) The New York Times 1976: August 26, 41-1 and October 27, 43-3.
  - (6) The New York Times 1975: August 27, 56-3; October 25, 41-2; October 27, 43-3.
  - (7) Richard L. Sklar: Corporate Power in an African State. University of California Press, 1975, pages 42-47.
  - (8) Financial Times: International Business Year Book, 1976.

The Anglo American group has an important stake in the Rio Tinto Zinc and Amax. Conversely the First National City Bank, the group that exercised control of Anaconda and influence on Kennecott, owns 15% of the shares of the Charter Consolidated, one of the subsidiaries of Anglo American.

In 1976, there was a merger between the Anglo American and the Roan Selection Corporation (1); the latter is a diamond producer.

The Rio Tinto Zinc Corporation is the greatest mining group based on the U.K. It has interests in several minerals. Its penetration in copper mining has been extraordinarily dynamic in the last ten years. Its mining possessions (iron ore, copper and uranium) are relatively new and the technology relatively advanced.

The Charter Consolidated qualifies the Rio Tinto Zinc as a trade investment associate (2), as it controls no less than 10 and no more than 50 per cent of the shares of RTZ (3).

In 1978, RTZ reached a joint venture agreement with EXXON to develop some mineral deposits. Although the minerals included in the programme were not specified, it can be expected that copper will be one of them, considering the three acquisitions of copper deposits recently made by EXXON, in Chile and the U.S. The joint venture programme has been considered as one of the measures adopted by RTZ to protect itself from a take over by the oil companies (4).

Metallgesellschaft AG is the largest metal processing and metal semi-manufacturing company in Germany. It is also involved in chemical production and transport. By the end of 1978 it reached an agreement with the government of the People's Republic of China to build 11 non-ferrous processing plants in that country as part of the programme of industrial modernization.

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(1) Financial Times: International Business Year Book, 1977/78.

(2) U.K. Edition of Who Owns Whom 1976/77.

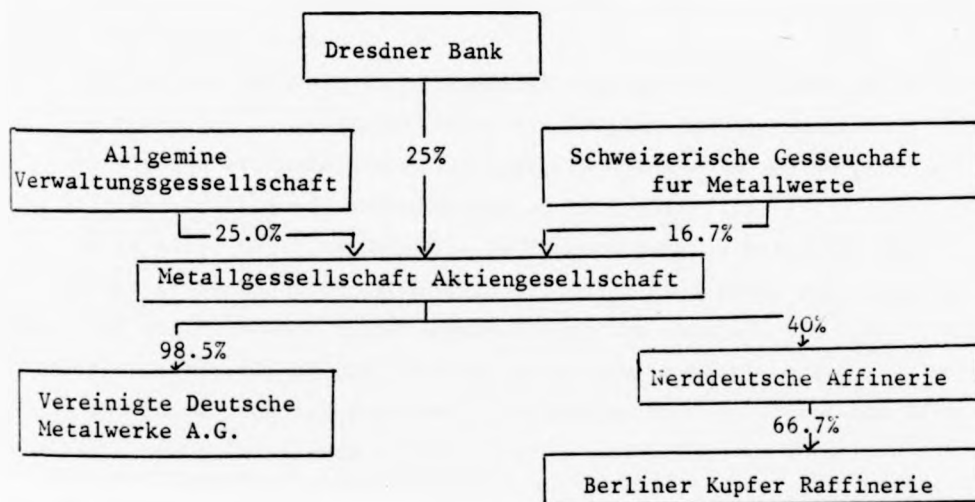
(3) In 1976, it was announced that the Charter Consolidated had sold 10 million shares of its holding in RTZ, (Financial Times International Business Year Book, 1976) but it would seem that the Charter still maintains an important stake.

(4) The Economist: September 16, 1978, page 84.

Metallgesellschaft is controlled by the Dresdner Bank, the second largest bank in West Germany (1) and Allgemeine which is an industrial holding (2) equally controlled by three companies (3): a) Siemens A.B., one of the largest electrical engineering companies in Europe, b) the Deutsche Bank A.G. and c) Allianz Versicherung, the largest insurance company in West Germany; Schweizerische is the third company involved in Metallgesellschaft.

Metallgesellschaft has connections with four of the six smelters and refineries of copper in West Germany, these plants having 80% German capacity of treatment of copper. The companies Vereinigte and Norddeutsche Raffinerie Vereizeiste Deutsche, Berliner Kupfer Raffinerie and possibly Huttenwerke Kaiser (4).

Figure 5.2  
The Metallgesellschaft Group



- (1) Financial Times: International Business Year Book, 1976 and 1978/79.
- (2) Who Owns Whom: Continental Edition 1976/77.
- (3) Jane's Major Companies of Europe, 1976.
- (4) The relation with Huttenwerke is based on information taken from Roskill Information Services Ltd. Copper 1976. But their inter-relation could not be confirmed with the sources utilized in this study.

Norddeutsche Raffinerie is also owned by Degussa, 40 per cent, and the British Metal Corporation, a subsidiary of the Amalgamated Metal Corporation which is 50.2% owned by Patino N.U. In turn Norddeutsche owns 12.7% of the Amalgamated Metal Co.

Metallgesellschaft group also controls at least 40% of the semi-elaboration copper facilities of the country.

Metallurgie Hoboken control 73 and 94 per cent of the Belgian smelting and refinery capacity, if its French connections are included, 0.8 and 8.1 per cent of the market economies smelting and refinery capacities, respectively.

Metallurgie is controlled by the Societe General de Belgique through the holding specified in Figure 5.3, it also controls the total treatment facilities of France. The Societe also owns Union Miniere, the former owner of Cie. Miniere de Haut Katanga, the copper producer of Zaire, nowadays, in spite of nationalisation, the group has an important influence on the Zairean company through managerial and technical assistance and commercialisation contracts; furthermore, Metallurgie Hoboken refines 50% of the Zairean copper.

The Societe Generale is a financial company with a diversified portfolio of investment (1). It claims to be the Belgian largest bank.

As a rough estimate the group controls between 70 and 80 per cent of the Belgian capacity of semi-elaboration of copper (2).

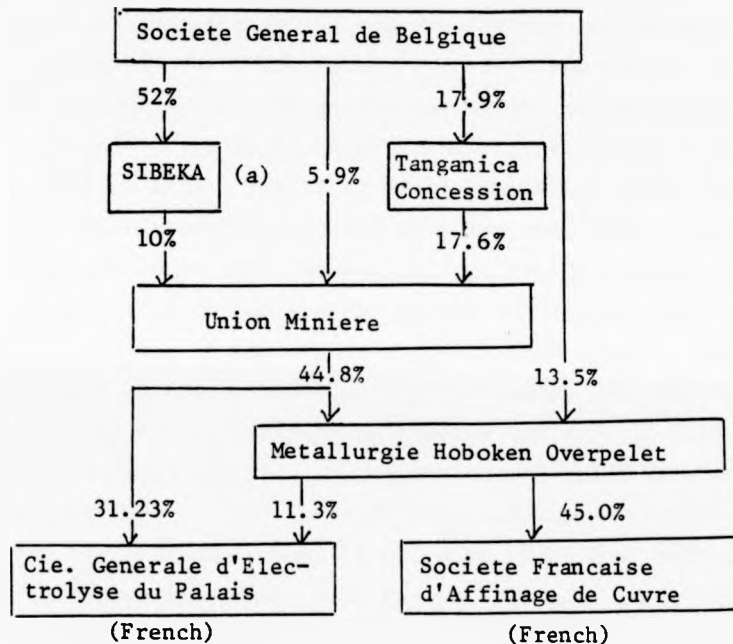
It is noted that the Generale du Electrolysis du Palais is also a subsidiary of Pechiney Ugine Kuhlman (3) which is a group that control about 80% of the French copper semi-elaboration capacity (Pechiney claims that it controls 20% of the European capacity of semi-elaboration of copper (4), to be the fourth leading producer of aluminium and to control the largest stainless steel facilities of Europe.

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- (1) The distribution of the portfolio was as follows in 1975, bank, insurance and finance companies 36%; non ferrous metals and others 19% iron and steel 10%; energy and high level engineering 11.0%; building and property 6.7%; electrical and mechanical engineering 5.0%; miscellaneous 10.0%.
  - (2) World information about capacity of production of semi-elaboration is incomplete and not entirely comparable.
  - (3) This group is the result of the merger of Pechiney and Ugine Kuhlman in 1971. The distribution of the net sales of the group were as follows: aluminium 34.0%; copper semi-fabrication 22%; chemical products 22%. steel and electrometallurgy 15% and special products, nuclear and mining 8%.
  - (4) Financial Times International Business Year Book, 1976.



Figure 5.3

## The Societe Generale de Belgique Group



(a) Societe d'Entreprise et d'Investissement du Baceka S.A.

In Japan the most important economic groups were organised around the old Zaibatzus (1) and still use the same names. Mitsubishi holds about 40 or 45 corporations; Mitsui 25 - 30 companies; Sumitomo around 20 large enterprises, the Fuji (2) nearly 17 and finally the Deichi Bank group and

(1) The Zaibatzu were the economic groups that controlled an important part of the Japanese economy until the end of the Second World War. They constituted a centralised family system that exercises the control through holding companies. The big four were Mitsui, Mitsubishi, Sumitomo and Yasuda which controlled 25% of the capital of Japan. During the occupation of Japan by the U.S. it was enacted the law for the Elimination of the Excessive Concentration of Economic Power and other measures that intended to break up the Zaibatzus. Although these organisations were affected in different intensity by such measures, they re-emerged but with another form of organisation.

A splendid description of the Zaibatzus, the form in which they were affected by the measures taken by the Occupation Authorities, can be found in G.C. Allen "Japan's Economic Expansion", Oxford University Press.

(2) This is no other than the former Yasuda Zaibatzu the fourth in importance at the end of the War.

the Industrial Bank (1) of Japan should be mentioned. As in other market economies there are, as part of the group, financial organisation which are a primary but not exclusive source of finance, but also a mechanism of co-ordination with the other groups.

The relation among the groups and the leading custom smelters are evident in the names of the companies, except in two cases. Furukawa Electric Co. is a member of the Daiichi Bank group and the Nippon Mining Co. Ltd. is controlled by the Fuji, Daiichi and Mitsui groups. The economic groups also control almost the total semi-elaboration copper concerns of the country. The Japanese producers have not made important direct investments in mining in other countries, but this situation is changing. The strategy was first to develop the custom smelter and then as a logical further step, to enter in the mining copper industry (2). They have direct investment in copper mines mainly in Canada, Peru and Zaire, but production of this source is still relatively small. It is noted that some groups have joint ventures in those projects relatively important in terms of investment. For instance Nippon Mining owned 80% of Sodimiza, in Zaire, but later 85% was owned by Codemiza where Dowa Mining Co. and Mitsubishi also have interests. In Panama, the most important companies have been developing a program of exploration, etc.

But the analysis of the direct investment of the Japanese companies abroad results in an under-estimate of their influence in the copper mining industry. An example may permit a better assessment. In 1968, the Mitsubishi and Mitsui group raised a loan of 42 million dollars for Nchanga Consolidated Copper Mines Ltd., which in turn had to supply 100,000 tons of electrolytic copper for a ten year period; part of that amount has been used in servicing the credit. In addition Nchanga was given a credit facility of up to 28 million dollars for the purchase of Japanese equipment. It is noted that this amount of copper represents about 10% of Japanese consumption and almost the total amount of refined copper (3) imported by Japan; it also represents 13% of Zambian copper production.

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- (1) The Industrial Bank, according to Chitosi Yanaga (Big Business in Japanese Politics) is the Bank of the joint ventures of the Daiichi and Fuji group.
  - (2) In 1973, Japan was participating in 52 projects of mineral development abroad, their geographical distribution was as follows: Middle East 1, South East Asia 11, Oceania 4, Africa 9, Central and South America 12, North America 15. This list includes projects which were at the stage of exploration.
  - (3) See P.A. NarasimraMurthy: Japan's Dependence on World Resources and its Resources Policy. International Studies, April-June 1975, Vol.14, No. 2.

Japan has participated in the financing of copper projects in Indonesia, Papua New Guinea, Philippines, Australia, Canada, Chile and Peru. Part of the loans are payable with copper output. In most of the cases producers of those countries sell either concentrates or blister which are treated in the Japanese custom smelters.

Japan uses the financial flows to meet her long-run copper requirements. Indirect investment is not only used by Japanese producers but in this case seems to be more important due to the intensity and effectiveness.

The few and inadequate available data about fabricating facilities show that the Japanese groups which own the custom-smelters also control a significant proportion of the fabrication capacity of this country (their share is not lower than 80%).

#### 5.6.2.3 Diversification of the leading copper producing companies

Most of the private companies involved in copper have implemented programmes of diversification. Unfortunately it was not possible to compile aggregate information about this process, but on the basis of a case by case study it can be concluded that the copper companies are more diversified than in the 1950s.

The causes determining the implementation of such policy seem relatively clear: to reduce dependence of their revenues and profits on the market conditions of one product; to spread the risk to different market conditions, which lead to financial flexibility and independence from a product characterised for its highly volatile price. By moving towards a more dynamic market they also increase their capacity for growth and by shifting efforts to more profitable products their capacity of accumulation.

Anaconda for instance, entered into the aluminium industry which apart from being the closest substitute for copper, has had the highest rate of expansion among the minerals in the last 25 years. Nowadays, Anaconda is the fifth aluminium producer in the U.S.

In the early 1950s, 54% of the AMAX's sales were copper. In the following years Amax diversified into oil and gas exploration and production, began the production of potash and light metals, and merged with Climax Molybdenum. In 1959, the composition of AMAX's sales was as follows: copper 59%, oil and gas 9%, molybdenum 9%, tin, silver and gold 14%, lead and zinc 6%, others 3%. In the 1960s, AMAX moved into the aluminium industry acquiring first smelting facilities and then by integration back into mining; it merged with a coal company but sold its oil and gas

interests. By the early 1970s, copper, lead and zinc were 36% of its sales; aluminium 37%, molybdenum and refractory metals 21% and coal, potash and oil 6% (1).

In 1968, Kennecott bought the second largest coal producer in the U.S., Peabody (2). Almost immediately legal proceedings started against Kennecott on the grounds that the acquisition violated the U.S. anti-trust laws. In July of 1977, the Federal Trade Commission forced Kennecott to divest itself of Peabody Coal; the U.S. Peabody's concerns were sold to a group of six companies led by Newmont Mining Co., while Peabody's Australian operations went to Broken Hill Proprietary Co. In November 1977, Kennecott bought Carborundum, the second abrasive producers in the U.S. but also a producer of industrial machinery, liquid pumps, waste incineration and filters (3)

Table 5.21

Composition of the sales of some of the corporations involved  
in copper operations (in percentage)

<u>The Anaconda Copper Co:</u>	copper and copper products 69%, aluminium and aluminium products 24%, uranium oxide 2%, other products 5%.
<u>Anglo American Corporation:</u>	gold 44%, diamonds 17%, coal 3%, copper 9%, platinum 3%, other minings 2%, industrial activity 16%, finance 6%.
<u>International Nickel Co:</u>	primary nickel 53%, refined copper 16%, formed metal products 25%, precious metals 4%, other 2%.
<u>Metallgesellschaft:</u>	metals (included copper) 51%, fabrication 26%, industrial plants 10%, chemical plants 10%, transport 3%.
<u>Mitsubishi Metal Co:</u>	copper 48%, zinc 12%, lead 3%, gold 6%, silver 4%, fabricated products 23%.
<u>Newmont Mines Corporation:</u>	copper 66%, gold, silver, oil, gas and other products 34%.
<u>Rio Tinto Zinc:</u>	copper and gold 23%, borax and chemicals 9%, lead and zinc 15%, aluminium 8%, iron ore 10%, uranium 2.6%, tin 4.3%, oil 0.5%, others 5.3%.

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- (1) R.P. Rumelt: Strategy, Structure and Economic Performance. Harvard University Press, 1974.
  - (2) R. Loving Jr. How Kennecott got Hooked with Catch-22. Fortune, September 1971, pages 99-101 and 140-143.
  - (3) R.P. Rumelt: Strategy, Structure and Economic Performance, Ob.cit. pages 17-18, 182.

According to the analysis of Lamont (1) the most acute problems of the International Nickel Company (INCO) derived from its high dependence on nickel, and to a lesser extent on copper. In the 1950s INCO controlled 85% of the nickel in the market economies but in 1974, it only controlled 40 per cent. In 1974 it entered into the battery and motor industry through the acquisition of ESB (2) and in 1975 into the market of forged products by purchasing Daniel Doncaster and Son Ltd., a British based company (3).

Datas about the contribution to sales by products for some of the private corporations are included in table 5.21 which suggests that their degree of dependence on copper varied considerably from one case to another.

In spite of the intense programme of diversification of the leading copper companies their revenues are still highly dependent on copper. Classifying them according to the importance of the contribution to sales by copper, three groups can be distinguished. The state owned companies are the most dependent of all, above 80 per cent. In four of the private companies copper represents between 50 and 70 per cent of their sales: Anaconda (4), Newmont, Noranda and Phelps Dodge. Kennecott and ASARCO may well be in the lowest limit of this group. Four other primary producers are relatively diversified, Amax, Anglo American, INCO and Rio Tinto Zinc.

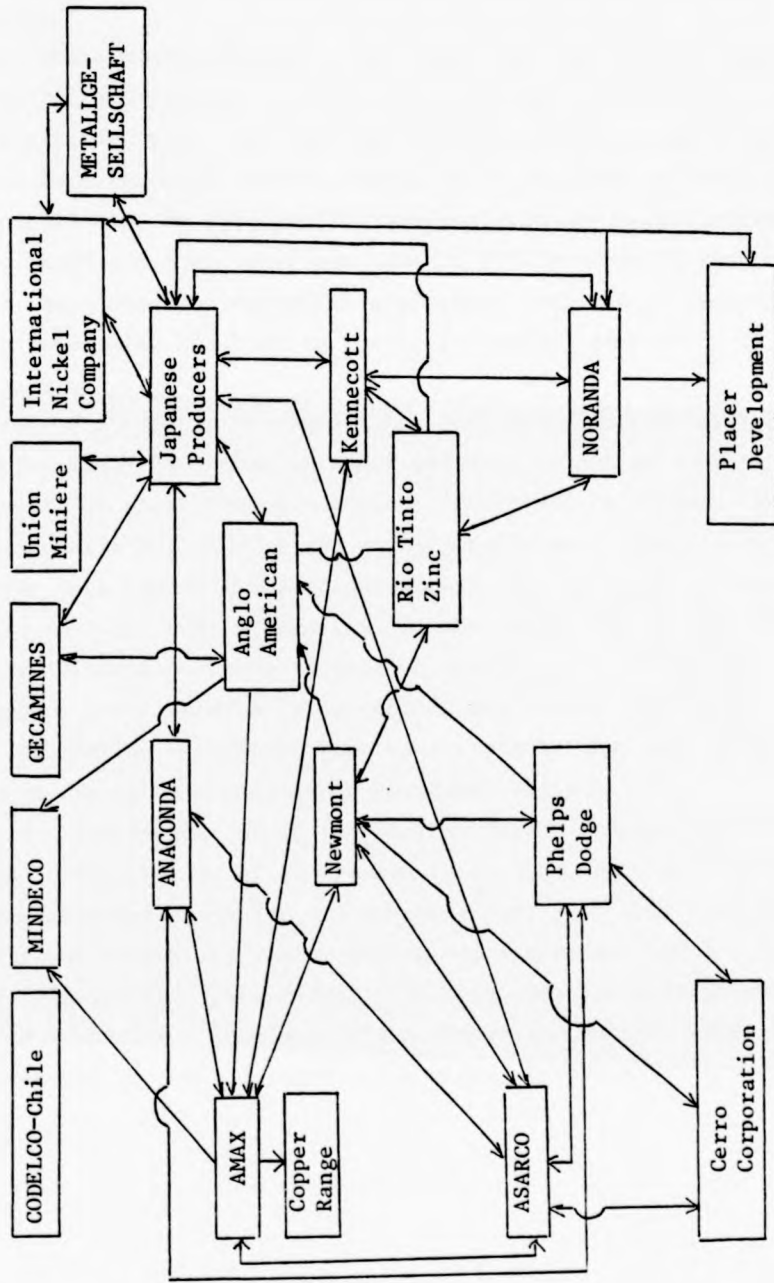
#### 5.6.2.4 Company inter-relations

The description of the inter-connections of the copper companies through joint ventures is presented in Appendix 1 and they are summarised together with the corporate ownership inter-connections in Figure 5.4. Compared with those existing in the early 1960s, it has in common that each of the leading producers is involved in joint ventures with at least two companies. If the direct and indirect interlocking directorship and contractual relations for the treatment of copper had been included, the net of connections would have considerably increased.

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- (1) L. Lamont INCO: A Giant Learns How to Compete. Fortune, February 1975.
  - (2) INCO: Annual Report, 1975.
  - (3) INCO: Annual Report, 1976.
  - (4) The situation has obviously changed after being absorbed by Atlantic Richfield.

Figure 5.4

Corporate and company inter-relations among the leading copper companies



Sources: Appendix 1 and Table 5.22

The current inter-relations diverge from those of the 1960s in that the three state owned companies have almost no inter-connections with the private companies. In the 1960s, they were part of four of the leading producers.

Two of the state owned companies share ownership with the private companies: The Zairean producer with the Japanese but in a relatively small copper mining venture; the Zambian with AMAX and Anglo American. These relations have tended to weaken through time, in 1964 nationalisation of Charter Consolidated, in 1969 partial nationalisations of the copper subsidiaries of AMAX and Anglo American, and in 1974 re-negotiation of the managerial, marketing and technical assistance contracts; the policy of the Zambian government has been to become gradually independent of AMAX and Anglo American.

Company and corporate inter-connections re-inforce market inter-dependence. The firms develop areas of common interest and have to define common policies at least for their common concerns; their points of departure have to be the general policies of the parent companies. The policy making process involves exchange of information which in itself tends to increase the sensitivity to each other's behaviour in the market and to look for mechanism to attack destabilising tendencies operating in the market.

These company and corporate inter-connections are an additional mechanism of information exchange; when used properly they may yield data on complex issues on a relatively permanent basis.

Research and development of the technology of exploration, extraction and processing of the nodules of the seabed is an area where most of the companies from different countries are co-operating. In this area the mining corporations have joint ventures with oil companies, steel producers and aviation and space firms. In this area there is no company from developing countries. Table 5.22 summarizes information about the structure of capital of the 6 largest ocean mining companies.

Table 5.22

Deep Ocean Mining Consortia

I. Ocean Mining Associates		V. Ocean Management Inc. (d)	
Essex Iron (a)	33.3%	International Nickel Co.	25.0%
Union Miniere	33.3%	AMR (Metalgesellschaft, Preussag, Rheinische Braunkohpenwerke and Salzgitter)	25.0%
Sun Oil Co.	33.3%	Deep Ocean Mining Co. (Sumitomo, Nippon Mining, Dowa Mining and other Japanese companies)	25.0%
II. Deep Sea Ventures.		SEDCO Inc.	25.0%
U.S. Steel	22.2%	VI. Continuous Line Bucket Group (e)	
Union Miniere	22.2%	Australia: Broken Hill Pty. Ltd.	
Sun Oil Co.	22.0%	Canada : INCO, Dome Mines, Placer Mining, Teck Corp., Noranda, Cominco.	
Tenneco (b)	34.6%	France : Societe le Nickel and CNEXO.	
III. Kennecott Copper Co.		Germany : Preussag AG, Metalges- ellschaft, Salzgitter.	
Kennecott	50.0%	Japan : Nippon and Sumutono Industries.	
Rio Tinto Zinc	10.0%	U.S. : Ethyl Corp., Occidentals Minerals, Superior Oil, Utha International, U.S. Steel, General Crude Oil, Atlantic Richfield.	
British Petroleum	10.0%	VII. Frenach Association	
Consolidated Gold Field of South Africa	10.0%	CNEXO	
Mitsubishi of Japan	10.0%	Societe le Nickel	
Noranda Mines of Canada	10.0%	Chartier de France.	
IV. Ocean Minerals (c)			
Amoco Minerals (subsidiary of Standard Oil Indiana).			
Billiton Metals BV (Royal Dutch Shell).			
Bos Kalis Westminster			
Ocean Minerals BV (Dutch).			
Lockheed Missile and Space Company.			

- (a) Wholly owned subsidiary of U.S. Steel.
- (b) Early in 1979 Metalgesellschaft bought 20% of the shares of Tenneco which controls rich mineral concessions in Canada.
- (c) There is no information about the participation in the shares of the company.
- (d) The Japanese and German interests were considering withdrawal to continue exploration independently.
- (e) This consortia consists of about 20 companies of 6 countries. The participation in the company is ignored.

Sources: Engineering and Mining Journal, September 1978. Financial Times, July 21st, 1978, page 20. Leipziger-Mudge: Seabed Mineral Resources and the Economic Interests of Developing Countries. Ob.cit.



### 1.7 The structure of the consuming market by companies (1)

As already noted in this chapter, the information about the semi-manufacturing copper industry by companies is inadequate and insufficient.

Only a general appraisal can be given for some of the largest copper consuming countries in the market economies: Belgium, France, Japan, Germany, the U.K. and the U.S.

In the U.S., the primary producers control about 60 per cent of the semi-manufacturing industry.

In Belgium, Germany and Japan a significant proportion of the semi-manufacturing industry is connected to the custom-smelters, between 70 and 80 per cent in Belgium, at least 40 per cent in Germany and about 80 per cent in Japan. In at least two of these countries, important producers of electrical machinery and equipment are closely associated to the semi-manufacturing and custom-smelters. In the mid 1970s, only one of these custom-smelters had investment in copper mining but supplying a small part of its total demand for copper.

In France, about 80 per cent of the semi-manufacturing industry is controlled by Pechiney, the most important copper company of this group is Trefimetaux. Pechiney has connection with the two French refineries where Union Miniere has also a stake. It is important to note that most of the French copper is imported from Belgium.

For several years the French semi-manufacturing industry has operated a co-operative in charge of importing most of the copper requirements of this country. The importing organisation also has government support which has recently helped to finance stocks of copper.

In the U.K., three semi-manufacturers concentrate 70 per cent of the wrought copper output of this country. In Italy two companies concentrate between 70 and 80 per cent of the copper semi-manufacturing industry.

On the basis of the information compiled it can be said that the structure of the semi-manufacturing industry in the copper importing countries does not approach the purely competitive structure suggested in some studies (2) this is an oligopoly which has a relatively important bargaining power.

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- (1) I am grateful to Mr S. Olivarez for the information about industrial concentration of the semi-manufacturing industry.
- (2) B.R. Stewardson: The Nature of Competition in the World Market for Refined Copper. The Economic Record, June 1970, pages 172-173.

In three countries, few custom-smelters process and semi-manufacture an important part of the copper requirements; the copper consumption of these countries represent about 45% of the market economies outside the U.S. These custom-smelters buy the copper in large quantities and on a long contract basis; their suppliers become relatively tied to their processing facilities.

The custom-smelter and semi-manufacturing producers play an important role in financing investment in primary production. Moreover, they have programmes of exploration and are looking for opportunities for direct investment in primary production overseas. In these programmes they have the support of their governments: for instance, the West German Economics Minister after evaluating the results of the first seven years of West Germany's policy of support for overseas mineral exploration and development, urged the mining groups to adopt a bolder approach and assured them that the government would not fail to adapt the existing guarantees to new forms of operation (1); the Japanese policies will be examined later.

The European and Japanese semi-manufacturing industry are grouped in the International Wrought Copper Council. This organisation co-ordinates the promotional work of the national centers, compiles information, undertakes technical and marketing studies; exchanges information and, as most of the producer's organisations, tries to define common purposes and criteria on relevant issues or development related to the industry.

#### 1.8 Relative advantages of the governments owned copper companies

The structural changes which took place in the copper industry affected the companies in different degrees. The change for the former leading producers was already considered. Now it is necessary to analyse how it has affected the government-owned companies.

The take-over by the governments took place in relatively unfavourable conditions:

- a) Lack of managerial staff with experience and in some cases skilled workers to fulfil the functions required to take the control of the companies.
- b) Lack of experience of working together with their rivals.

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(1) Financial Times, November 30th 1978, page 5.

- c) Financial, competitive disadvantages. This problem must be considered from two points of view. First, when the companies' financial situation is associated with that of the country; their position is highly unfavourable, as it could be seen in the analysis of the external debt of these countries. Second, if it is assumed that the companies are independent of the financial conditions of the country, they have still a competitive disadvantage in relation to the private companies because the latter have ownership connections with important sources of finance. Besides in equal conditions the financial organisations will tend to support the private company, one of the several reasons is that they have a longer technical background in the industry.
- d) The financial situation of the government owned companies is more dependent on the market conditions of one product than the private industries.
- e) As the countries usually have balance of payment deficits it can be assumed that the governments will tend to operate the industry according to short-run rather than long-run policies. This may well make more difficult the possibility of producer co-ordination and therefore long run profitability.
- f) Company activities are developed in only one geographical area so their results are related to the general conditions prevailing in that country. Theoretically it is possible to conceive the government owned companies investing in other areas, but they would be in contradiction with one of the principles in which nationalisation was based, that the surplus were invested in the national territory and not in other areas.

Partly, as a result of the unfavourable competitive conditions affecting both the nationalised companies and their former owners during the period that preceded and followed the nationalisations, it was easier for some copper firms to expand at a relatively high rate. These are the cases of ASARCO, Rio Tinto and Noranda (if it is considered as one unit with Placer) and the Japanese custom-smelters.

### 5.9 Conclusions:

The structure of the copper industry experienced significant changes in 1950-75 as a result of which the seller and the buyer market has become more competitive.

The world copper industry can be subdivided into three different though inter-dependent subsystems according to the origin of supply of the primary copper, the role of copper imports and/or exports and the characteristic operation of the market: the centrally planned economies (CPE), the U.S. and the international market.

The CPE have considerably increased their importance as producers and consumers of copper; they are basically self-sufficient though their trade with the market economies has tended to increase gradually. The importance of the U.S. has drastically declined in the last 25 years but it is still the world leading producer and consumer; it is a net importer of copper but its imports have been less than 10% of her consumption.

The international copper market is composed by a large number of consuming countries but six of them concentrate most of the consumption. These six countries are almost totally dependent on copper imports for their supply: this situation will not change because these countries have neither hypothetical nor speculative copper resources.

Competition to secure the sources of supply tended to increase in the international market: firstly, concentration of copper consumption though still highly concentrated has been declining. On the one side, the number of leading consuming countries has tended to increase, on the other side, other countries have been improving their position. Secondly, until 1963 few companies controlled most of the reserves in the market economies. In 1964-69 the governments ended the concessions on undeveloped copper deposits in four areas, which reverted to the States. Companies from different countries are trying to gain access to these resources. After the period of low growth in the 1970s, competition for these reserves will tend to increase.

In the international market copper production is also highly concentrated in few countries, though concentration also has been falling. Nations which were marginal producers in the early 1950s have increased their importance as exporters of copper: Australia, Peru, the Philippines and South Africa. Another group of countries became copper exporting nations in the 1970s, namely, Iran, Indonesia and Papua New Guinea. Another two will also become important exporters: Mexico in 1979 and Panama possibly in 1982-1985.

The copper exporting countries constitute a group of relatively heterogeneous countries. There are significant differences in their level of economic and social development; the diversification of their exports and the extent in which their foreign exchange revenue depend on their copper exports. The degree of vertical integration from mining to refining also varies considerably from one country to another.

Despite the multiple economic, political, social and historical differences there are some areas of common interest:

- a) Raw materials are a significant part of their exports. The expansion of their exports has been considerably affected by the process of recession-inflation affecting the market economies.
- b) All of them have defined as a goal to increase their vertical integration as a mechanism of increasing employment, value added, and foreign exchange revenue.
- c) These countries are all interested in developing a copper semi-manufacturing industry to supply the international market. In this prospect they are all affected by the protective measures of the consuming countries.
- d) Concern about the relations between the mining companies in general and copper producers in particular and the central or local governments have increased in these countries. The governments, in turn, are extraordinarily inter-dependent on the decisions they can adopt whatever the direction of their policies.

Considerable changes in the structure of the copper industry by companies also have taken place in the last 25 years, whose results also tend to increase competition.

- a) Considerable reduction of concentration of production both in the market economies and among the leading suppliers of the international market.
- b) None of the largest mining producers of the market economies in the early 1950s are among the leading suppliers of the international market of the 1970s.
- c) Except ASARCO, the leading copper companies in the U.S. are not the same as those of the international market. This makes more difficult the co-ordination between the producers of the two systems. Until the late 1960s, the leading producers of the U.S. and international market were the same.
- d) The custom-smelters increased their importance in the period, situation which is related to the low degree of vertical integration of the primary producers. Some of the primary producers were integrating vertically in 1970-78, but the role of the custom-smelters will continue being significant.

The increasing importance of the custom-smelters makes more competitive the market at mining, because on the one hand it reduces the financial requirements of a new entrant who may even obtain financial support from them: on the other hand, because the profits of the custom-smelters are rather independent from the price of copper which in turn play a significant role in the net earning of a primary producers. Moreover, the custom-smelters tend to consolidate a system in which products at different degrees of elaboration (concentrates, blister, refined) and marketing characteristics are traded. This also makes more difficult the co-ordination of the decision of the producers.

e) In the 1950s and early 1960s, the interdependence determined by the existence of few suppliers was reinforced by a net of joint ventures and a system of direct and indirect inter-locking directorates which related most the leading suppliers of the market economies. In the 1970s, these inter-relations still persisted but only among the private companies. The state owned companies (three of the leading supplying companies of the international market) had connections with only four private companies.

f) New entries into the copper industry, considering as such entirely new firms which produce a new product, are relatively few: they do not concentrate more than 10 per cent of the output.

However, considering also as new entrants those companies which, on the one hand had small concerns but considerably expanded them, in this case the Japanese and the RTZ would have to be considered; on the other hand, the new companies formed by the governments after the nationalisation. Considering these situations the results are completely different, most of the copper is supplied by new firms in the international market.

g) A process of merger, take-overs and programme of joint-ventures agreements, has been taking place in the market economies. One company was absorbed by an oil producer and possibly another will follow. Two suppliers of the aviation industry have bought a relatively important part of the shares of another two copper companies and another corporation has reached a joint venture agreement with an oil company. (1)

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(1) Two other U.S. companies experienced drastic changes in their corporate structure: in 1976 Cerro Corporation merged with Marmon Group Inc., forming the Cerro-Marmon Co. In 1977 Copper Range became a wholly owned subsidiary of Louisiana Loical Exploration Co.

Both these companies were relatively small but vertically integrated copper concerns.

This process will probably continue involving other suppliers.

In the international market, copper consumption is also relatively concentrated in the largest consuming countries. Three of the largest consuming countries concentrate a considerable treatment capacity controlled by few firms, basically one in Belgium and Germany and three in Japan; in these three countries the custom-smelters control a considerable proportion of the semi-manufacturing industry, between 40 and 80 per cent.

In two other large consuming countries the semi-manufacturing industry is also highly concentrated, one firm controlling about 80 per cent of the French market; in the U.K. three firms control 78 per cent of the production; in Italy, two firms control 75 per cent of the semi-manufacturing capacity. It is likely that in other consuming countries the semi-manufacturing industry is also relatively concentrated in a few companies. It follows that the relevant consuming market is an oligopsony.

It can be said that the international market experienced significant changes in the structure during the last 25 years. The supply side maintained its oligopolistic structure but has become more competitive. This was due partly to the process of nationalisations and the reactions of some agents to this process and partly to the new geographical structure of the consuming countries. As will be seen in the next chapter, the changes of structure resulted in a modification of the behaviour of the producers in the mid 1960s and a process of intense competition during the slump of the 1970s.

CHAPTER 6Behaviour of the Copper Industry, 1950-72

This chapter deals with three collusive agreements in the international copper market in 1950-66 and the causes why the producers did not define a common policy in 1966-72 in spite of the threats of new entries, substitution of copper by other materials, increasing risk of unco-ordination of the investment decisions of the leading producers and the implementation of a consistent strategy of the copper consumers.

The chapter was subdivided into two parts, the period 1950-66 and 1966-72. This is based on the different mechanism of co-ordination adopted by the producers. This division is not rigid or absolutely strict; to give continuity to the study of one variable or group of situations, their analysis is continued beyond the time units defined.

In 1950-66, except in Chile, the relation between host governments and multinational companies had a secondary role: the privately owned leading companies, as in any oligopolistic relatively concentrated market co-ordinated their decisions though with different degrees of success; except in 1950-53, they simultaneously made the output-price decisions and had the dominant role in the industry.

In 1966-72 several changes took place simultaneously in the structure and behaviour of the industry. The role of four leading companies was drastically reduced through partial or total nationalisation and three state owned companies became important suppliers of the market. These changes were not paired with a common policy, a situation which made easier other changes in structure, behaviour and patterns of trade. In developing countries, the host governments played an important role in the inter-relations among producers. Early in this period, the suppliers of the international market adopted the London Metal Exchange as a basis to set the price of copper. This apparently formal change in behaviour was to make more difficult the possibilities of co-ordination and the definition of an oligopolistic discipline.

The period 1950-66 is in turn subdivided into two (1950-54 and 1955-66) because in the early 1950s, the behaviour of the industry was predominantly determined by exogenous conditions: the direct intervention of the governments of the industrialised countries as a result of the Korean war and scarcity of raw materials. This analysis was considered important as an example of collusion of the consumers in the face of shortages of



raw materials and to counteract the use of producer power. The second subperiod includes an unsuccessful attempt of collusion and the operation of one of the most successful attempts to stabilize the price of copper in the postwar period.

## 6.1 The period 1950-66

### 6.1.1 The sub-period 1950-54

It must be borne in mind that the analysis of this period is relatively complex because policies and the decision making processes operated in a relatively dynamic political and economic context: second, the decisions related to the copper industry were part of a general raw material policy adopted by the consumer countries; these policies were the result of several negotiations and developments, apparently unconnected but all of them orientated towards a relatively well defined overall objective; third, some of the situations are connected with developments in the forties, but to maintain the analysis within the scope of this study references to those "out of period" situations will be made only when considered relevant.

The analysis considers the following general scheme: 1) definition of the political context; 2) rough picture of the raw material situation, some of the relevant problems and characteristics of the raw material policies of the consumer countries; 3) the copper market; 4) the International Material Conference in general; 5) negotiations related to the copper industry outside the International Material Conference; 6) Copper and the International Material Conference; 7) the Chilean experience and 8) Conclusions.

#### 6.1.1.1 Defining the political context

It is not intended to give a complete picture of this period but to define some of the situations which must be taken into account when assessing the development of the copper industry in 1950-54.

In the immediate post-war period there were significant political changes. The wartime alliance between the West and the USSR turned into rivalry. Seven East-European countries became socialist.

In May 1949 the People's Republic of China was established and the German Democratic Republic was set up. This happened one month after NATO and the Federal Republic of Germany had been formed.

To characterise the relations between the East and the West, the term "cold war" was coined. Probably one of the most important deterrents of

a "hot war" was the new weapon that both super-powers had already developed in the forties, the atomic bomb.

Three of the conflicts which were going to be of public concern for more than 20 years had already begun: Berlin, Indochina and Arab-Israeli relations.

It was also the period of the European Reconstruction, but in the late 1940s rationing of consumer goods was ending in most of the European countries.

During the postwar period the process of decolonization started, first in some of the territories which had been occupied by the countries defeated in the Second World War and later in those areas controlled by other European countries.

Although the gap between rich and poor countries existed, there were two predominant forces on the political scene, the First World and the Second World (socialist and capitalist); what is now known as the Third World had not yet defined any common objective but some of the ideas which can be found in their declarations had already been published and were publicly discussed.

In June 1950 the War in Korea broke out. The same month the United Nations, except the USSR, condemned North Korea, and military forces of the international organisation were organised to help South Korea. The predominant role was taken by the U.S. but other nations also participated in that confrontation. In November 1950, Chinese voluntary troops began to support North Korea.

The Western Allies adopted a policy of collective defence and a combined rearmament program whose implications were going to be of importance in this period.

It must be borne in mind that the U.N. Commander, General McArthur, was of the opinion that the only way of winning the war was to invade China. The President of the United States disagreed with him and, when this became publicly known, McArthur was dismissed as Commander of the U.N. Army in April 1951.

The possibility of a wider war was without doubt realised by the governments of the Allies which had a tight control on the market of strategic materials. Such expectations increased the demand for raw materials, and prices started to rise mainly in the fourth quarter of 1950 and the first two months of 1951.

### 6.1.1.2 A rough picture of the raw material situation

The second half of the 1940s was relatively favourable to the primary producers. Consumption increased by a much larger percentage than population with respect to the pre-war situation: the conversion from war to peace production was faster than expected, increasing the requirements of both agricultural and mineral commodities: there was an additional demand for strategic stockpiling mainly in the U.S., but other governments in Europe were also accumulating stocks. The international market became competitive on the buyer's side and on average the demand for these products increased by 60% in relation to pre-war levels.

In 1948 the market for agricultural products began to ease and in 1949 the prices of minerals started to fall; the latter situation was basically due to the first recession of the post-war period in the U.S. In the first half of 1950 the downward trend persisted until the conflict in Korea started.

Three general phases can be distinguished in the overall raw material situation in the market economies from the start to the end of the Korean war.

The first was a general increase in demand with the consequent rise in prices.

The larger prices increase took place in those commodities of which the U.S. was a large importer. An index with a pre-Korean base 1950 shows that the price of tungsten was 528%, wool 340%, rubber 320%, tin 260%. The prices of copper, lead and zinc were controlled by the governments of the consumer countries. Although there is inaccurate information on the quotations in the unofficial market, the prices of the three metals were about 120 or 160 per cent above the pre-war levels.

The second period was one of adjustment and most of the products began to lose their previous gain and some of them fell to levels below those prevailing before the war started (wool, tea, cotton) but in a few cases prices continued to rise.

This period covered the last three quarters of 1951 and the first two of 1952. It began when the definite character of local war was given to the Korean confrontation and this influenced demand expectations. A general raw material policy was agreed among the consumer countries and special measures were adopted in those cases in which the shortages persisted.

The third period lasted for the remaining two quarters of 1952 and the first of 1953 when the effects of the second post-war recession began to be felt. A general and definitive trend toward the normalisation of the price levels but with wide fluctuations from case to case took place: the controls and special measures adopted with regard to some products began to be relaxed or suspended. Gradually but persistently the centralised mechanisms of decision were transferred to the market.

In the early 1950s there was a more general complication affecting the international market, namely the dollar shortage. It was accompanied by a surplus of commodities in the dollar area, while shortages affected the other areas; material prices were higher in Europe than in the U.S. which was regarded as a dangerous competitive disadvantage by the European countries. This problem specially affected the U.K. which had already devalued Sterling which was still weak in 1950: this situation, in turn, influenced the other European countries.

When the Korean conflict started, the U.S. government adopted several simultaneous measures to assure the supply of raw material during the emergency: they can be illustrated by considering those affecting copper; the Export Control Act of 1949 was being implemented and the number of products subject to restriction and quotas was increased; the level of the stockpiling targets for strategic materials was doubled in 1950; maximum prices for a large range of commodities were imposed; credits for expansion of capacity of final products considered unnecessary were reduced; restrictions of the civilian use of some commodities were imposed; control of the stock build-up both by consumers and manufacturers were established; and bilateral negotiations for long-run provisions of some raw materials started to be implemented. Liebhafsky characterises this policy as exporting as little and importing as much as possible (1).

The European countries reacted by reducing their exports of raw materials and semi-manufactured goods and increased their imports of strategic materials, despite the rise in prices. Moreover, they began bitterly to criticize the policy of their ally.

The shortage of raw materials became an important concern of organisations such as the North Atlantic Treaty Organisation and the Organisation of Economic European Co-operation (2).

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(1) H.H. Liebhafsky: The International Material Conference in Retrospect. Quarterly Journal of Economics, Vol.71, No.2

(2) Board of Trade Journal, 20 January 1951.

Liebhafsky tries to demonstrate that the U.S. stockpile policy had an unimportant influence on commodity prices with the following argument "The very sharp increase in stockpile appropriations beginning July 1950 is noted. In the last six months of 1950 stockpile buying was only slightly larger than during the previous six month period. A much larger increase occurred in the first half of 1951". And he concludes "Since the most extreme rise in price occurred in the last half of 1950 and the first two months of 1951, it seems that expectations played a more important part in the price rises than did actual stockpile buying" (1). The contradiction is evident. The bitter reaction of the European countries was due to the fact first, that stockpile appropriations were orientated towards products which were relatively scarce in the European countries; second, there is concensus of opinion that some U.S. exports were too drastically restricted, as for instance sulfur (2) and molybdenum with the consequent price effect.

For the U.S. it became more evident each time that a change in her raw material policy was necessary otherwise the collective defence programme and her relations with the European countries were going to be affected.

A co-operative attitude was decided on after negotiations between the British Prime Minister and the U.S. President on December 20, 1950 when some mechanisms to overcome the situation were defined; the policy of the U.S. was announced by the President in his message to Congress on May 27, 1951 and it was implemented in the Declaration of the Director of Defence Mobilization on the Allocation of Resources to Foreign Needs, released to the press on May 29, 1951 (3), the general principles of which were ratified by other official documents and President Truman's Economic Report to Congress in January 1952 (4). It is noted that the raw material policy was defined after MacArthur had publicly disagreed about the character of the Korean war and been dismissed as commander of the U.N. forces in Korea.

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(1) H.H. Liebhafsky, Ob.cit.

(2) U.S. Dep of Commerce: Quarterly Report on Export Control. March 31st, 1951.

(3) Keessing's Contemporary Archives 1950-1952, page 19498.

(4) The Economist, January 26th, 1952.

The policy statement of the U.S. government defined that the allocation of these commodities had to be based on the following criteria: military production and support to the requirements necessary for the current mobilization; to keep to a minimum the requirements for essential civilian consumption; to promote activities conducive to a future reduction of the dependence on military and economic assistance from the U.S.; to reduce the dependence of the market economies on raw material supplies from the socialist countries, and finally to prevent political deterioration in nations or areas essential to the combined strength of the countries of the West (1).

The British position that economic stability could not be impaired by rearmament objectives was not considered a basic aspect and the Economist commented that it was "almost impossible to persuade American industry and people to accept it" (2): but the mechanism in operation permitted pressure on the U.S. government to reduce its stockpile acquisitions, to negotiate U.S. export quotas, and to establish a structure for allocating commodities in short supply.

#### 6.1.1.3 The copper market

In 1950, the U.S. concentrated more than 50% of the copper consumed by the market economies while the U.K. was the second largest consumer with a market share of 14%, which was equivalent to about one-third of West European consumption.

In the U.S. the restrictions on copper which were imposed during the second World War were removed in 1946. The U.S. had become a net importer in 1939 and though the import duty on copper was suspended it still existed.

The operations of the London Metal Exchange had been suspended when the Second World War began and they were not to start again until 1953.

In the U.K., as well as in other European countries, the controls adopted during the Second World War still persisted and were maintained until 1953. Controls included a variety of economic policy instruments: a government monopoly of import and internal trade allocation of copper to manufactures through quotas; price fixing of both primary and secondary copper, export controls and when tight market conditions existed, control of the stocks held by manufacturers were introduced.

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(1) Statement of Policy by the U.S. Director of Defence Mobilization (Wilson) on the allocation of resources to foreign need, May 29, 1951.

(2) The Economist, March 3, 1951.

In the U.S., the war controls were relaxed in 1946; the copper prices were set by the producers and followed a pattern similar to that described in the analysis of raw materials: an increase in the immediate post war period until the recession of 1949. Despite the large strategy stockpiling purchases by the U.S. government, see table 6.1, producers were forced to cut production; in the U.S., output was reduced by 15%; Anaconda and Kennecott cut the production of their Chilean subsidiaries by a higher percentage; the Central African copper suppliers did not reduce their output voluntarily but by shortage of energy combined with problems of transport. These problems persisted until 1953.

Table 6.1

Consumption of the U.S. and market economies. U.S. net strategic stockpiling acquisitions 1948-1953

(in thousands short tons and in percentage)

A) Year	1948	1949	1950	1951	1952	1953
B) U.S. Consumption	1,421	1,130	1,124	1,417	1,480	1,255
C) Market Economies	2,631	2,330	2,711	2,876	2,913	2,829
D) U.S. Stockpiling acquisitions	79	213	228	65	22	112
E) $\frac{D}{B} \times 100$	5.6	18.8	16.0	4.6	-	8.9
F) $\frac{D}{C} \times 100$	0.3	9.1	8.4	2.3	-	4.0

Sources: Consumption: American Bureau of Metal Statistic.  
Net stock piling acquisition, based on N.N. Reddy: US. Stockpile Policy, Ob.cit.

When the Korean conflict began, the U.S. government fixed the price of copper at 24½ cents per pound. This situation led to the U.S.-Chilean negotiations, and as a result of this Chile agreed to sell most of her annual copper production to the U.S., and the U.S. were prepared to pay to Chile 3 cents more than that paid to domestic suppliers.

After the U.S. decision, in the most important consuming countries the price of copper was fixed by the governments; at the beginning of the Korean war the prices were basically the same, consideration taken of the cost of transport. However, the measures to meet their requirements were totally independent and uncoordinated.

Besides these official prices there operated a free market: "grey market", according to the copper jargon. As far as it was possible to determine, the government did not adopt measures against those involved in this market, but their decisions were obviously orientated towards the restriction of the operation of this market. In Europe the copper bought by the governments and sold to semi-manufacturers and other consumers was subjected to strict control, so it is likely that only marginal amounts of this copper were diverted to the other market. There are no estimates of the volume of trade which took place in this market: it can only be said that early in this period was relatively more important, and thereafter it gradually decreased. The free market was a substitute for the LME as a physical market but less organised. In 1951, the operation of this market was implicitly accepted by the consumer countries when they recognised the right of the Chilean government to dispose of 20% of her production without restrictions.

The U.S. acquisition for strategic stockpiles, equivalent to 8.4% of the 1950 copper consumption of the market economies, and the appropriation of four-fifths of the Chilean copper production considerably affected the European countries whose major sources of supply, the Central African colonies, could not expand production due to energy shortages. The European countries had to begin to buy copper at higher prices. In the case of the U.K. whose copper price was based on that existing in the U.S., the government changed its policy and started to base its price on the cost of acquisition.

The transactions at unofficial quotations were made at prices which fluctuated around a level equivalent to twice that fixed in the U.S. (1) (2).

But independent buyer action was also a dominant characteristic in other products: a situation which made it difficult to solve the problems through negotiations on a product by product basis; no government of a consuming country would accept an understanding in a product over which the country had an important degree of control, without an understanding in those commodities whose supply was controlled by another.

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- (1) The level of prices mentioned here are based on The Economist but obviously their figures are not based on official registers.
  - (2) The difference between these prices was not only the result of the independent action by the consumer countries, other inter-related factors were also operating in the same direction: the prices fixed by the governments were relatively low; the expectation of an extension of the war so more drastic restrictions of copper supply, speculation also played an important role.



Copper was only one product, among several others in short supply; the effectiveness of the copper price control depended on the capacity to co-ordinate the decisions of the consuming countries which in turn depended on a more general framework whose definition had to result from negotiations at a high governmental level due to the strategic character of the raw materials involved in a period of emergence.

6.1.1.4 The International Material Conference, in general

The International Material Conference was the result of the negotiations between Attlee and Truman in December 1950; the announcement of the agreement received the immediate support of France. All three governments proposed the Conference as a mechanism to increase supply and availability of materials in short supply and to promote their most effective use (1). It was decided that the U.S. government should invite other friendly governments and the three sponsor governments established a temporary group to organise the Conference. The new organisation was set up with unusual speed by international standards.

The International Material Conference (ICA) consisted of a central group and a number of committees, each responsible for one or more related products.

The U.S., the U.K. and France originally represented the central group but later it was expanded and incorporated Australia, Brazil, Canada, India, Italy, representatives of the Organisation of American States (O A S) and the Organisation for European Economic Co-operation (2). It is noted that 3 out of 7 were representatives of the Commonwealth and that only two were from underdeveloped countries. The functions of the central group were to co-ordinate the work of the commodity groups, and, if necessary, to set up new commodity groups.

There were originally five commodity groups but the number was later increased to seven. Each committee was autonomous and dealt with a single product or a group of related products; each committee was differently composed, being represented by those governments of the capitalist countries which had a substantial interest in the commodity concerned, either as a supplier or as a consumer. Countries which were not members of a committee had access to it and could present their points of view.

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(1) Board of Trade Journal, January 20, 1951.

(2) The Economist, March 3, 1951 and March 24, 1951.

The functions of the committees were to study the current situation and to forecast the trends of supply and demand for the commodity or product concerned; to propose an international allocation system if there was a shortage of the product in question; to examine methods of expanding production and reducing consumption. The committees had no power of decision, their recommendations had to be unanimous and had to be made directly to the participating governments.

The Conference concentrated its efforts on 14 commodities which were considered in real or potential shortage conditions, but international allocation schemes were established for only 8 of them; sulfur, copper, zinc, tungsten, molybdenum, cobalt, nickel and newsprint. When the studies of the commissions revealed that no shortage existed, no action was taken.

The work of the Conference started in February 1951 and the last Committee was dissolved in September 1953. It is noted that it started to operate when the commodity prices had already reached their peaks and prices had begun to fall. Table 6.2 includes the date at which each committee started and terminated its work; the list of countries participating in the Conference, and their distribution by committees in December 1951. France, Germany, the U.K. and the U.S. participated in all the Committees, but Germany was not a member of the central group. Belgium and Canada participated in six Committees while Australia, Brazil and Italy belonged to five.

Table 6.2

## International Material Conference

Commodities Committees operating in December 1951

	Copper Lead Zinc	Sulphur	Cotton Cotton- Linters	Tungsten Molybden- um	Manganese Nickel Cobalt	Wool	Pulp Paper
started to work	2/26/51	4/30/51	3/5/51	3/8/51	3/13/51	4/2/51	4/30/51
was dissolved	3/31/53	4/30/53	9/15/52	7/31/53	9/30/53	9/25/52	9/18/52
COUNTRIES							
Argentina						X	
Austria							X
Australia +	X	X		X		X	X
Belgium	X	X	X		X	X	X
Bolivia				X			
Brazil +		X	X	X	X		X
Canada +	X	X	X	X	X		X
Chile	X			X			
Cuba					X		
France +	X	X	X	X	X	X	X
Germany	X	X	X	X	X	X	X
India +		X	X		X		
Italy +	X	X	X			X	X
Japan			X	X			X
Mexico	X	X	X				
Netherland							X
New Zealand		X				X	
Norway	X	X			X		X
Peru	X		X				
Portugal				X			
Spain				X			
Sweden		X		X			X
Switzerland		X					
Turkey			X				
Union of South Africa		X			X	X	
United Kingdom +	X	X	X	X	X	X	X
United States +	X	X	X	X	X	X	X
Uruguay						X	
Number of Countries	12	16	13	13	11	11	14

+ designate members of the Central Committee.

\* designate members of the Commodities Committees.

6.1.1.5 Negotiations related to copper other than those in  
International Material Conference

Three negotiations which took place outside the Raw Material Conference were especially important.

6.1.1.5.1 The O E E C resolution

In the first quarter of 1951 the U.K. government prohibited the fabrication, for the domestic market, of 200 items made from copper. When they were produced for external markets (1) licenses were required; their approval depended on the following requirements: the value of the final goods, compared with the value of the copper or copper alloy content, had to have a conversion ratio of at least 15 times in the case of export to the dollar area or the Commonwealth, and of at least 50 times in the case of exports to other markets (2). Other European countries adopted similar measures. But if those decisions were uncoordinated they would have been ineffective in restricting the use of copper.

In September 1951, the OEEC announced in Paris that the member countries had agreed to prohibit the use of copper in a list of products in order to conserve this metal for re-armament purposes. In addition, no country could export to other members products on the prohibited list. The U.K. had to add about 30 new items to her original list.

This measure had a marginal effect in the period under consideration, specially if one considers that some of the prohibited goods used marginal amounts of copper. But the list also included electrical products, and their manufacturers were being compelled to use substitutes for copper. It is difficult to define how important these decisions were but in 1955-6 aluminium began to make inroads into the copper market (3). It is most likely that the investment in research and development facilities made by the aluminium industry in the period had the support of the governments (4) of the industrialised countries.

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(1) Copper and Zinc Prohibited Uses (Board of Trade) Order 1951, SI 1951 No. 275 and Copper Zinc Prohibited Uses (Ministry of Supply) Order 1951 SI, 1951 No. 277.

(2) The Economist, February 24, 1951 and March 10, 1951.

(3) J.L. McCarthy: The American Copper Industry, 1947-55. Yale Economic Essays. Vol. 4, page 119.

(4) R. Dammet and K.D. Durant Ed's: Documents on American Foreign Relations. Vol. XI11, 1951.

6.1.1.5.2 Restrictions on the sale of strategic materials to the socialist countries.

There was a general policy of the U.S. and some Western Allies to restrict the trade with socialist countries in general and the People's Republic of China and North Korea in particular (1). Several measures were adopted by the U.S. in this direction. Two of them are the most important in this context: the approval of the Kem Amendment (2) which was later replaced by the Mutual Defence Assistance Control Act (3), better known as the Battle Bill. The latter provided for the withdrawal of U.S. economic and military aid from countries shipping strategic materials to socialist countries. Its difference from the Kem Amendment was that the new legislation in this respect added the withdrawal of military aid and it permitted to the President to make exceptions, while the older provided for the application of sanctions automatically. The second was an agreement signed early in 1952 by the U.S. and 10 European countries (Belgium, Denmark, France, West-Germany, Italy, Luxembourg, the Netherlands, Norway, Portugal and the U.K.) whereby the signatory agreed to improve the existing system of control of shipments so to ensure that strategic products were not re-exported to socialist countries (4). A few months later Canada signed the agreement.

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- (1) Within this policy framework was the resolution moved by the U.S. in the UN which recommended, among other actions, "to apply an embargo on the shipments to areas under the control of the Central People's Government of China and the North Korean authorities, approved by the General Assembly on May 18, 1952. Additional information on this issue can be found in Keessing's Contemporary Archives 1950-52. UN Resolution on China 11245 A; Additional Measures Committee, China 12277 C; U.S. Embargo 11157 A; British Embargo on Rubber Exports to China 11478 A.
- (2) Keessing's Contemporary Archives, 1950-52. President Truman opposes to Kem Amendment, June 9-16, 1951 page 11527 D; Three months suspension of Kem Amendment, October 27-November 4, 1951, page 11527 D.
- (3) Keessing's: Ob.cit.: The Mutual Defence Control Act, 12080 B; Strategic Goods, Shipments to Communist Countries, Stricter Control, Ap.25-May 2, 1953, 12894 A; U.S. The Battle Act: President Truman orders continue Economic and Military Aid to Great Britain, France and Italy. Dec. 27 1952-Jan, 3, 1953; East-West Trade: Relaxation of Strategic Controls on Export to Soviet Block-U.S. Restrictions under "Battle Act". Rejections of Senator McCarthy's Allegations. U.S. Foreign Programme Exception from Battle Act Granted to European Countries, Ap.24-May, 1st, 1954, p. 13452 D.
- (4) Keessing's: Ob.cit.: Agreement with Western European Countries on Prevention of Strategic Materials Exports to Soviet Block, Feb. 23 -March 1st, 1950 52, page 12040 A.

The objective of these measures were defined by Mr Stassen in one report on the Battle Act, two years after it had been approved; he stated that the controls "had substantially satisfied the objective of retarding the build-up of Soviet war making power" but that "a combination of the Western world's newly found strength and its "by-product" surpluses in some commodities made it advisable to relax some of the restrictions applicable to the Soviet bloc".

In relation to copper, it was not possible to compile information on the measures adopted in each primary exporting country. The U.S. situation is self evident. The U.K. prohibited the exports not only of unwrought copper but also semi-manufactured products (1). Belgium and Canada signed the pact to ensure that strategic products did not reach Socialist countries. The Chilean government signed another agreement with the U.S. whereby copper was not to be exported to Socialist countries (2).

It was not possible to define for how long the prohibition lasted but, as a matter of fact, copper trade with Socialist countries only started in 1955.

The implications of these decisions were multiple: the countries and areas more dependent on their copper refrained, or were forced to refrain, from exporting to the countries with a more dynamic rate of growth; copper consumption was expanding at an estimated rate of about 7.5% in the socialist countries as against about 4.5% in the market economies. Second, the decision was adopted when bargaining power was favourable to the raw material producers: there were shortages of copper in the market economies and it is likely that a similar situation was effecting the socialist countries, (because in a relatively short period the USSR had to begin to supply copper to the Eastern European countries and to China). Moreover the socialist countries were interested in overcoming the restrictions imposed over them.

It does not follow that entry into the socialist countries could have been easy. There were also other difficulties, e.g. that they had different modalities of trade to those prevailing in the market economies and were also facing deficits of Western currencies. From the point of view of the market-economy consuming countries, restrictions to the socialist area improved the supply of copper. Third, the socialist countries were compelled to develop their own sources to supply their requirements; an important

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(1) Reports of the Monopolies and Restrictive Practise, Supply and Exports of Copper and Copper based Alloys, 1955.

(2) Documents on American Foreign Relations, Vol. XIII, 1951 Edited by R. Dammet and K.D. Durant.

potential market was forced to become totally self sufficient.

The only politically independent underdeveloped country producing copper was Chile. The decision has been justified by the people involved in the government at that time on the basis of the internal and international context. This is questionable at least as regards the international context: India did not accept any type of restriction on her international trade; nor did Sweden and Switzerland (1). Other European countries restricted their trade in raw materials and other strategic products, but considerably increased trade with socialist countries in other products (1). Even more, industrialised countries traded in products considered strategic by the U.S., for instance the U.S. President had to suspend at least twice the application of the Battle Act to Denmark (2), France, Italy and the U.K. (3). When these restrictions began to affect the interests of the European countries, they began to press for the changes in the criteria used by the policy makers in the U.S. and finally succeeded (4). The Chilean policy makers, without any other product to compensate their need for new markets to expand exports, accepted such a restriction.

6,1.1.5.3 The Washington Agreement between Chile and the U.S. Government.

In September 1950, the U.S. Government fixed the price of the domestic and imported copper at 24.5 cents per pound. The decision affected Chile because the U.S. was her most important copper market, but the Chileans were not even notified of this measure.

It seems necessary to refer to a prior experience of the Chileans of copper price fixing by the government of the U.S., because its results greatly influenced their negotiations and the outcomes analysed later on. During the Second World War, the U.S. government took over the distribution

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- (1) Keessing's: Ob.cit. Report on the operation of the Battle Act, page 12894 A.
- (2) Keessing's: Ob.cit. 1953-1954. Denmark. Rejection of U.S. protest against delivery of Danish Tanker to Soviet Union. page 12354 A and 13542 A.
- (3) Keessing's: Ob.cit. 1953-54. President Truman orders Continued Economic and Military Aid to Great Britain, France and Italy, Dec.27 1952-Jan. 3 1953., page 12648. U.S. Foreign Aid Programme Exception from Battle Act granted to European countries. Ap. 24 May 1st, 1954.
- (4) Keessing's: Ob.cit. 1953-54. Sir W. Churchill's statement on the House of Common on 25 February., expressed wish to bring about increased trade with the Soviet Union. Page 13476 A: Report on the meeting of British French and U.S. delegations in London on March 29-30. Discussion held by the Consultative Group Coordinating Committee, (NATO members plus Japan and Germany) page 13802 A. W. Churchill-D. Eisenhower discussion in Washington on June 25-28, 13665 A.

of copper at a fixed price of 12 cents per pound of refined metal. The system also included subsidies paid to the domestic high cost producers, permitting an increase of output from high cost mines. The average cost of copper to the U.S. government was between 13 and 14 cents a pound, which compared to 23 to 26 cents per pound paid in the First World War represented an enormous saving.

The Chilean government accepted the price adopted in the U.S. Depending on the basis of the calculations, the Chilean foreign currency loss has been estimated at between 150 and 500 million dollars (the average price of copper in the First World War or prices paid to higher cost producers in the Second World War). The policy adopted by the Chilean government was heavily criticized in the light of the more independent policy adopted by the Argentinians in the same period and the price increase of Chilean imports both during the War and after its end. Moreover, the market share of Chile had experienced a drastic reduction with respect to world output, from 22% in 1943 to 13% in 1950.

When the U.S. government froze the price of copper it did not consult the Chileans. There was an immediate public and political reaction against such a decision. The Chilean government sent a commission to the U.S. to negotiate a price increase, but agreement was not reached until a second Chilean group took over the negotiations in March 1951 (1). The eventual agreement established that Chile was to sell 80% of the production of the large scale mining industry (subsidiaries of Anaconda and Kennecott) to the U.S. which was to pay 27½ cents per pound for it. Moreover credits to develop the small and medium size Chilean mining industry were going to be provided by the U.S. The U.S. did not accept a proposal to eliminate her copper import duty.

Representatives of Anaconda and Kennecott also participated in negotiations and agreed that the difference between both official prices was to go to the Chilean government. They also agreed to sell 20% of their Chilean production, at the U.S. official price for domestic copper, to the Chilean government.

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(1) Radomiro Tomic: *Primeros Pasos Hacia La Recuperacion del Cobre*. The author of the article participated in the Chilean Commission who negotiated the agreement and gives interesting and valuable information on the negotiation itself. R. French-Devis and E. Tironi Ed's: *El Cobre en el Desarrollo Nacional*. Ediciones Nueva Universidad, 1974.



The agreement lasted one year. When it ended negotiations did not reach agreement (1) and the government of the U.S. was forced to change the maximum price for copper manufactures, so the fabricators and consumers could buy copper at the free market price: it also sold 70,000 tons from her strategic stockpile to force price reductions in the free market.

#### 6.1.1.6 Copper and the International Material Conference

Despite the defined objectives of the Commodity Group of the International Material Conference (ICA), the only effective action they were able to adopt was related to the international allocation of the raw materials among the consumer countries. Agreement on restriction of consumption was adopted by the OEEC because the measure would have invited the opposition of the producers, had it been discussed at the Conference.

Recommendations to expand production would not have had any practical implication due to the transitory character of the Conference. Ceiling and floor prices were discussed at the very beginning but later the subject was abandoned (2).

The Copper Commission made two kinds of recommendations to the governments of the members of the Conference, an international allocation among consumers and export restrictions of semi-manufactured copper products.

Six quarterly allocation schemes were approved by the copper commission, the first for October - December 1951 and the last for January - March 1953.

The amount to be allocated corresponded to the total copper exported by the major producers except Chile whose government reserved her right to dispose of 20% of her production without reference to the allocation scheme.

Allocation among consumers was made considering re-armament requirements first: the remaining amount was allocated on the basis of the 1950 market share consumption of the capitalist countries whether or not they participated in the Conference although special circumstances of individual countries were considered. The sources from which a country was to be provided were not specified: each country was free to purchase copper from any source or to sell to any destination within their allocation, but it was asked to respect traditional patterns.

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(1) According to the Economist the Chilean government asked a price of 33½ cents per pound when the free market price was about 40 cents. The Economist, May 10th, 1952, and June 7th, 1952.

(2) The tungsten committee approved a maximum and minimum price scheme but had to abandon it.

Each government assumed the responsibility that purchases did not exceed her quota and no measures were devised against cheating, since the dangers of retaliatory measures which could be applied to uncooperative members were only too evident.

The export restriction of semi-manufactured products of copper was based on the level prevailing in 1950.

The amounts of copper allocated by the Copper commission are specified in Table 6.3

Table 6.3

Total Copper allocated by the Copper Commission of the ICA  
(metric tons)

Year	1951		1952			1953	
	4th	1st	2nd	3rd	4th	1st a) b)	
Tons	677,160	744,680	723,630	744,290	747,655	723,680 (c)	

Sources: Board of Trade Journal, several issues.

- a) The Committee agreed to make arrangements whereby users of any country could have the opportunity to purchase copper allocated but not used by another country.
- b) Allocation was discontinued in February 15, 1953.
- c) At the time of the allocation there was a strike in Northern Rhodesia.

During this period there were two different price situations. The first lasted until the end of the US-Chilean agreement. In the U.S. there were two prices fixed by the government, one for domestic production, at 24.5 cents a pound, the other for copper imports, 27.5 cents per pound; the European Governments fixed the price (as far as it was possible to determine) following that of the U.K. When the first allocation scheme on copper was approved by the Copper Committee of the ICA the free market prices were about 100% above the European fixed prices. In the second period the U.S. government maintained the fixed price for domestic copper but it introduced more flexibility to the system of controls, allowing the consumers to buy in the free market; the European Governments had to increase theirs and maintained the prices at the new level until August of 1952 when they began to be reduced gradually but persistently. Early in this second period the free market prices were about 40 to 50 per cent above the fixed prices and they began to fall thereafter.

Early in the second semester of 1952 there was evidence that supply conditions were improving and demand was recovering normal levels in relation to supply: i.e. quotas allocated to consumer countries were not entirely taken up: the studies of the copper committee showed that demand exceeded supply by a smaller amount. But control and restriction only began to be suspended in September 1952, when the Council of the OEEC removed a group of articles from the prohibition list of end-uses. Successively and gradually each country re-established pre-emergency conditions and transferred decision to private economic units. This process culminated in May 1953, when the British government announced that private trade in copper would be restored. The Copper Committee of the ICA had already suspended the allocation scheme and its dissolution had been approved in March 1953.

The allocation system introduced by the Copper Committee was important to maintain control over the level of prices, but it was only one of the mechanisms adopted by the consumer countries to produce that effect: other measures, such as the restriction of excessive purchases for government and private stockpiling, reductions of civilian consumption and governmental control of prices, also made an important contribution. But the allocation scheme was especially important in three respects:

- a) To reinforce cooperative buyer behaviour and restore buyer discipline instead of the destructive competitive conduct prevalent when the Korean war broke out.
- b) To negotiate collectively with producers and if possible to obtain their cooperation.
- c) To act on expectations of both producers and consumers through collective analysis of the supply and demand conditions.

The evaluation of the whole policy adopted by consumers cannot be made by comparing prices that prevailed in the free market and those fixed by the governments, because consumer collusion considerably affected both of them. But it is possible to conclude that had uncooperative buyer behaviour prevailed prices would have been higher and for a longer period.

#### 6.1.1.7 The Chilean experience

As a result of the Washington agreement, Chile reserved the right to dispose of 20% of her copper production. This right was upheld by an Act approved by the Chilean Congress early in 1952 whereby the government was authorized to market the copper production by the large scale industry which was until then monopolized by the foreign companies according to

another law. The new law was approved in spite of the opposition of the affected companies Kennecott and Anaconda. The organisation responsible for selling the copper was the Central Bank of Chile, this Bank is the body responsible for monetary and international trade policy, but it lacked experience and infrastructure to implement the new functions, a situation which proved to determine the results of this experience. In 1951 it fixed an inflexible price of 35 cents (of dollar) per pound of copper and only 50% of the quota (1) was sold. This policy began to be applied when the industrialised countries had agreed and were implementing a policy to face the shortage of raw materials.

When the Korean conflict started, the Chilean Government had an important bargaining power which was only used to negotiate with the U.S. government. The U.S. was the most important market of the Chilean copper but this policy did not take into account the competitive relations which prevailed among the developed countries. But more relevant, in the Washington Agreement, the Chilean government accepted two elements which were to be the basis of the common copper policy of the industrialised countries: the control of the price and the control of 80% of her production. It is obvious that a different course of action involved the threat of retaliations against a small country but the policy adopted was highly restrictive.

At the end of the Washington Agreement, the Chilean government decided to buy the whole production of the subsidiaries of Anaconda and Kennecott at the official price for domestic production in the U.S. 24.5 cents and to sell it through the Central Bank. Information on the selling price is confused but there is consensus that it was at least 35 cents.

Though an important part of the Chilean copper must have been sold through long term contracts, the new decision implied that the marketing effort of the Central Bank considerably increased. The new decision was made while there was an increasing opposition from the foreign companies. The U.S. government did not react for three basic reasons: despite the fact that the objectives and implications were different, it was doing the same buying and re-selling the domestic copper in the domestic market at fixed prices; second, in the U.S. there was an increasing pressure to end raw materials price restrictions. For instance, one Senator for Michigan (the largest automobile producing state), presented an amendment to a bill in Congress providing that when there was enough supply for strategic materials

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(1) R. Tomic: Ob.cit. A Pinto Santa Cruz: Chile: Una Economia Dificil. Fondo de Cultura Economica, 1967.

in the U.S., buyers would have to be free to buy all the material they could at the prevailing price; the amendment was rejected but pressure increased. Third, one of the Candidates to the Presidency of the U.S. presented a peace settlement in Korea as one of the major points of his programme; a situation which presumably created expectations of peace and therefore of normalisation of economic conditions.

When the agreement with Chile ended, the U.S. government amended the maximum internal price for wrought copper in such a way that semi-manufacturers could buy copper at the free price in the international market.

It was not possible to find information on the level of Chilean stocks at the end of 1952 but it seems they had not increased very much.

In 1953, copper consumption was affected by the recession and the reduction of the demand for arms; the balance between supply and demand was re-established and the industrialised countries continued relaxing the regulations on copper, until the decisions were totally transferred to the market. In the U.S., after a period of transition, the prices of copper were lower than those prevailing in Europe in the free market but higher than 24.5 cents a pound. In August, the London Metal Exchange started its operation for the first time since the start of the Second World War.

Meanwhile, in Chile, the opposition by the foreign companies to the copper policy of the government had considerably increased. There were two main reasons for this, the subsidiaries of Anaconda and Kennecott then had the possibility of selling the copper at a higher price than 24.5 cents because the U.S. government terminated price control in February 1953; second, important cost pressures in Chile, due mainly to the fact that there were multiple rates of exchange and the one for the operation of the copper companies led to a considerably over-valuation of the national currency while internal prices increased.

At the end of 1953 Chilean copper production had fallen by about 30% and stocks were equivalent to 5 months normal production or 7 months after the curtailment.

The inconsistency of the policy of the Chilean government became more evident during the recession; the high cost of acquisition of copper did not allow a large enough margin to reduce the price as the rivals had. In 1953, for the first time in 20 years, the Belgian Congo began to sell copper in the U.S. entering Chile's principal market. Information which

was not possible to confirm suggests that the most important clients of Union Miniere were the semi-manufacturing plants of Kennecott and Anaconda; so the dominant suppliers of wrought copper in the U.S. were replacing the Chilean copper by Belgian copper.

It is necessary to consider the reasons why other suppliers did not collude with the Chilean sales agent to raise the price of copper. First, pressure by the government of the consumer countries: for instance, the U.K. had contracted copper supplies with the Rhodesian producers; when the Chileans began to sell their whole production at the free market price, the U.K. Minister of Supply negotiated with its copper suppliers: a higher price was agreed but much lower than that chosen by the Chileans; at that time Roan Selection Trust was trying to obtain a change of domicile to Rhodesia because of important tax advantages. This was finally accepted but only when market conditions had already improved. Second, the Chilean government was a potential entrant in the market whose major interest would have been to capture a larger market share. Third, collusion would have implied support of the Chilean decisions. So retaliatory measures by Anaconda and Kennecott could have been expected. Fourth, other producers preferred a long term strategy rather than a short term policy, this was particularly important for the Rhodesian producers which were completing a programme of investment.

In 1954, the Chilean stocks reached 130 or 150 thousand tons in spite of the reduction of production of about 30%. The Chilean government began negotiations with the U.S. companies: after the basis of an agreement had been reached the U.S. government decided to buy the stocks accumulated in Chile for strategic purposes. In 1955, a new legislation was approved by the Chilean Congress known as the New Treatment: the legal clauses which permitted the marketing of copper of the large size mines by the Central Bank were eliminated: and a relatively liberal policy began to be implemented.

The mistakes are too evident to be analysed in detail: therefore only three of them will be considered: a) The persistence in defining the whole policy in short-run objectives, completely ignoring the long term implications b) It also ignored producer interdependence which characterises an oligopolistic market; that each producer faces a kinked demand curve whose upper part is more elastic than the lower one; the upper part describes the amount sold if it chooses to raise the price and the rivals do not match the price; theory also suggests that the upper part of the curve is less elastic when suppliers are working at full capacity and a tight

balance of supply and demand exists. For this reason, 1952, the Chilean sale agent was able to sell a higher proportion of the total capacity of production than in 1953. The situation of 1951 can be explained by inexperience and the need for time to develop the minimum facilities and contacts required to sell a product in the international market. Third, retaliation by the private companies affected by the government decisions were easier than they would have been in other circumstances because the traditional market for the Chilean copper was the U.S., controlled by Anaconda and Kennecott, and because the Chilean agent had not attempted to penetrate the European market through a long-term policy. This situation gave an additional competitive advantage to both U.S. copper companies because if the copper import duty was re-established in the U.S., Anaconda and Kennecott would have had the possibility to retaliate by restricting domestic supply to those who had persisted in buying Chilean copper.

#### 6.1.1.8 Conclusions

International cartels were not alone in operating this raw material market. Consumer countries have also colluded, if not to obtain monopsonistic benefits, to constrain producers' price increases.

Prior to consumer collusion there was a period of uncooperative buyer behaviour in the raw material markets due to expectations of armed confrontation between the East and West. Balance of payment and monetary disequilibria were affecting some industrialised countries. After collusion began they started to adopt a variety of measures to face shortages of some primary products, but according to a generally agreed policy.

Several factors eased collusion and permitted coordination a) the governments of the consumer countries were facing a group of complex international problems, defined at that time as threats to their existence, one of them being the Korean military confrontation; there was a collective disarmament plan but its implementation was affected by raw material shortages. b) The group of leading consumer countries was smaller than nowadays and two countries were under military occupation by Western Allied forces since the Second World War, Japan and West Germany. c) Governments of the industrialised countries were directly intervening in the raw material market and had a tight control on it: they could easily impose their strategies on the private sector due to the emergency. d) Important supply areas were under colonial rule, thus controlled by the consumer countries: independent under-developed countries producing primary products

still had less power to exert pressure than they have now. e) Shortages of raw materials were caused by several confluent factors, but two of them could be modified without creating great confrontations of interests: expectations and strategic stockpiling acquisitions.

Two of the decisions adopted affected the structure of the industry for a long period 1) the refusal by the market economies to sell copper to the socialist countries, 2) the prohibition against using copper in a list of about 230 items by the OEEC countries. However, it is difficult to determine the significance of the latter.

The International Material Conference was one of the mechanisms of oligopsonistic coordination; it contributed to re-establishing cooperation and discipline among buyers; the collective analysis of the market conditions influenced expectations of both producers and consumers, permitted collective negotiation between producers and consumers and international allocation of the primary product among consumers.

The result of the oligopsonistic collusion cannot be evaluated by comparing prices in the free market and those fixed by the governments because buyer coordination affected both. But it is impossible to say that in conditions of destructive competitive buyer behaviour the prices of copper and other raw materials would have been higher and would have lasted for a longer period.

In regard to the Chilean experience, it was the first direct governmental intervention in the large scale mining industry. Strategic errors and mistakes were very evident and its complete evaluation must be part of the analysis of the copper industry of that country, but in general it can be said that a strategy cannot be based purely on short-term objectives, especially when this implies important changes of structure and/or behaviour. Second, in an oligopolistic market producer inter-dependence, as well as retaliation from those affected by a policy cannot be ignored as happened in this case.

#### 6.1.2 The sub-period 1955-64

This part deals with two producers' price experiences in the international copper market: 1) The Roan Selection Trust's price system. 2) The collusive agreement of 1957-66. As a background to the study of these experiences the most important strategic decisions of the leading producers are considered first.



#### 6.1.2.1 Introduction

After 1953, in the U.S., copper consumption began to grow at a lower rate than that of the other market economies especially if compared with Japan. It must be borne in mind that this change in structure had been forecast, influencing the decision of the leading producers.

In the second half of the 1950s aluminium started to make new inroads into markets historically dominated by copper.

In the first half of this decade the major copper producers had adopted a set of decisions which affected their long-run profit objectives: Kennecott, after the construction of a large refinery to process its copper in the U.S., decided to complete full integration and to become independent of ASARCO which processed its copper on a toll basis - Anaconda was entering into the aluminium industry, and it was trying to develop a new mine in Chile to replace the production in Potrerillos, which was nearly depleted.

In Chile a new legislation and policy for the copper industry was adopted, the tax rate declined as production increased and the government returned the control of the copper sales to the U.S. companies. Moreover, the government agreed that discriminatory rates of exchange were not going to be adopted against the two foreign companies. Anaconda, more dependent on the Chilean production, thus solved one of its major strategic problems.

ASARCO had always been a custom smelter but the decision adopted by Kennecott considerably affected her position so it decided to enter into mine production by developing a deposit in the U.S., under the support of the Defense Production Act, as well as one in Peru. To develop the latter, ASARCO set up a joint venture with other U.S. producers while maintaining majority control. When the process of vertical integration was completed, the long-run objective of ASARCO was to become more consistent with those of the other large producers despite the fact that part of its smelting capacity was to continue operating on a toll basis. ASARCO also entered into the aluminium industry through its affiliate fabricator Revere Copper and Brass.

Phelps Dodge had bought 10% of the shares of American Metal in 1948, and through it, Rhodesian Selection Trust. Phelps Dodge was also participating in Southern Peru, where it operated a joint venture with ASARCO.

Until 1953, the two Rhodesian producers refined an important proportion of their copper production in the U.S. from where it was shipped to Europe, the principal market of those two producers. But in the first half of the fifties they completed an investment programme in refining equipment, became much more independent and reduced transport expenses. Both producers were also investing in two new mines.

In this period the two largest copper consuming countries in the market economies operated strategic stockpiles, the U.S. and the U.K. Those of the U.S. were about 0.8 million tons, that is, 7.0 months of consumption of that country. Copper was withdrawn when there was a tight balance of supply and demand; net acquisitions were unimportant in 1955-66. Decisions to sell stocks reduced imports and depressed prices in the international market. In the U.S., the few suppliers had to take into account another variable in their output - price decisions, the possible movements of stocks. The U.K. stockpiles were much smaller, possibly 100-150 thousands tons, which had been accumulated during the period of direct intervention of the government in the copper industry. However, the policy of the government was more determined by the situation prevailing in the international market.

The effect of the different strategies of the participant in the market can be summarised as follows:

- 1) The 8 largest suppliers of the market economies maintained a large share of the total supply, about 70%, but the four largest producers experienced a reduction from nearly 53% in 1951 to about 45% in 1960 and 43% in 1964 (1). However, in terms of structure and operational characteristics the industry continued being an oligopoly.
- 2) As a result of the relative reduction of U.S. imports, an increasing proportion of the copper produced in Chile began to be shipped to Europe. The Canadian copper output increased faster than in other areas in the second half of the 1950s and their major market was Europe. The Central African producers faced greater competition.
- 3) The leading companies started to implement programmes of diversification. At least two of them entered to the aluminium industry.

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(1) See table 5.16.

d) Kennecott and ASARCO were the two non-vertical integrated producers in the copper market, in the sense that the former had no refining facilities and the latter did not own mines. Both of them increased the integration of their operations from mining to refining but both of them already controlled an important part of the copper semi-manufacturing industry in the U.S.

As a result of this development; most of the copper producing companies processed their production in their facilities. However, an important part of the refineries were located in industrialised countries.

e) In the final years of this period, two copper producing areas became independent, the Belgian Congo in 1960 and Northern Rhodesia in 1964, however the participation of their government in the copper industry was not important until 1966.

#### 6.1.2.2 The producer price system of the Roan Selection Trust in 1955-57.

This experience has been called the first African price experiment. But this term is not adequate because first, it was a pricing policy of only one African producer and the others did not follow it; second, it was not the first time that African producers fixed the price of copper, and third, it was not an experiment.

During the 1953-54 recession in the U.S. the reduction of demand for copper was compensated in part by strategic stockpiling. The net acquisitions (1) were equivalent to 12 and 24% of the U.S. production in 1953 and 1954, respectively; these acquisitions also reduced the pressures for a price decline in the international market: in 1954, they included the 130 or 150 thousand tons of stock accumulated in Chile. The U.S. producers cut production by almost 10% while in other market economies production increased.

Late in 1954 the industrial recovery started and demand for copper rose, but production was interrupted by strikes first in the U.S. and then in other areas, in the second half of 1955 and in the first half of 1956. The London Metal Exchange quotations, more sensitive to these situations increased faster than the U.S. domestic price.

In the second half of 1956 the price began to fall slowly but remained at a relatively high level, 35 cents per pound. In 1957 the price began to decline sharply because of the reduction in demand due to the new recession, and because new capacity of production was arriving on the market.

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(1) Net acquisitions: purchases less disposals.

Supply over ran demand by about 160,000.

After a long period of market control, all the leading suppliers of the international market began to set the price of copper but using different bases. The Chilean sold it at the Engineering and Mining Journal (EM&J) export price which was usually below the London Metal Exchange (LME) quotations. Union Miniere set its own price, as far as information is available, it fluctuated between that of the EM&J export price and the LME quotations, shifting towards one or the other depending on the market conditions. The Canadians used a domestic producer's price for their transactions in Canada (20-25% of this country's output) and, it seems, that they set their own price for their transactions in the international market. The Roan Selection Trust (1) and Anglo American began to sell theirs on the basis of the LME.

Despite that the system used by the producers resulted in a similar level of price, there was a potential risk that in periods of instability the prices may have evolved in different directions and that oligopolistic uncertainty and producers indiscipline could have ~~increased~~ competitive pressures among the suppliers of the international market. This is more relevant when considered that the producers had not been fixing the price of copper for a relatively long period.

In 1954, when prices began to increase, the British consumers met the Rhodesian producers and asked them to stabilise the price of copper.

In May 1955, Roan Selection Trust announced its policy whose objectives were to stabilise the price of copper and to prevent substitution. The company was to hold its price for 30 days and any change would be announced with a 24 hours notice. This policy was maintained until October 1957. Anglo American reacted by announcing that it was to continue to sell on the basis of the LME. Other suppliers reacted stating that both Rhodesian producers had to agree before any negotiations so they maintained their prices basis.

Despite the rival's reactions Roan Selection Trust persisted in its policy, and from May 1955 to March 1956, it sold at lower prices than those of the LME. The average difference between these prices was about 10%,

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(1) The name of this company was Rhodesian Selection Trust which was changed to Roan Selection Trust after the independent of Northern Rhodesia. In this text the latter is used.

but in one month it widened to 32%. The policy of the government of the two major consuming countries was to stabilise the price. The U.S. government reduced acquisitions for strategic stockpiling and sold 30,000 tons. The British government sold 65,000 tons between November 1956 and March 1957 (1), and the disposal method adopted supported the Roan Selection Trust initiative.

For eleven months only this company sold copper at a lower price than the rivals. But the dual price system affected the United Kingdom, the major market of the two Rhodesian companies: while prices were increasing, the consumers who were buying at fixed prices had an advantage compared to those who had to buy on the LME basis.

The policy of RST deserve a critical analysis because its objectives to stabilize the price of copper and to avoid substitution - do not make any sense when the policy is implemented by one firm which controlled only about 6% of the output of the market economies. RST expected to be followed, since it was selling a product in an oligopolistic market at a lower price than the rivals. But this is not necessarily true when demand is short of supply; the market erosion experienced by the rivals may be marginal at least in the short term, especially when the price cut is made by a relatively small supplier as in this case. A wrong appraisal of the situation may be possible. But why did RST persist in this policy for a year? There are plausible reasons to think that RST was basing its decision on long run considerations. RST was interested in the formulation of the more suitable basis for the output-price decision than the system prevailing during this period: the latter increased the risk of a break-down of the producer discipline in periods of change of the market conditions. RST were also interested in maintaining its long run position in its most important market, the U.K., while the proportion of the Chilean and Canadian copper reaching European markets was increasing. Finally, in the U.K. the possibilities of substitution were greater than in other countries; U.K. wire producers postponed the introduction of plastic wire; they produced mainly rubber insulated wires which were more expensive and less efficient than the plastic insulated variety (2); the leading

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(1) The Economist: October 13th, 1956, page 442.

(2) D. Swan: D.P. O'Brien; W.B.J. Mainer; W.S. Howe: Competition in British Industry, Case Studies. Electrical Cables, pages 334-355.

wire producers failed to respond to that development largely, it would seem, because of their substantial investment in rubber plantations and existing production equipment. This situation was relatively favourable to the aluminium producers who aimed to increase their market share in the wire and cable industry.

Anglo American did not follow because it could sell its copper at the higher price without losing market share: second, it was a highly diversified company so its long-term objective was not as dependent on the copper market as that of Roan Selection Trust; third, an important increase in copper supply was expected (1); fourth, Anglo American had invested in a new mine, Bancroft which was going to start production in expected declining price conditions.

The two foreign companies in Chile would not co-operate in such a policy unless those in Rhodesia solved their problems because there were critics of the new legislation approved by the government and of the price policy of the companies. The threat of substitution also existed in other markets but it was not as important as in the U.K.

When the price trend reversed, the application of the price policy of RST was modified in such a way that its price was on average a little above the LME quotations. In the light of the new conditions, a new attempt to establish a cooperative producers scheme was made. It followed the same general pattern which characterises these situations. The Chairman of both Rhodesian producers publicly announced the need for price stabilization and stated that there were conditions to set a producers' price. Representatives of both companies met in Salisbury and probably they contacted other producers. They reached an agreement on a new price strategy but decided to discuss it with the British consumers, which were supplied on a long-term contract basis (2). It is likely that consultation was also considered necessary because both producers were interested in maintaining the best possible relations with their clients as the Canadians and Chileans were selling an increasing proportion of their copper in Europe. Moreover, the British semi-manufacturing industry was trying to avoid a price war so it was important that their suppliers changed the dual price system as soon as possible.

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(1) Several projects were to reach the stage of production driving down prices and reversing market conditions, unless the leading suppliers reached an agreement to cut production.

(2) The Economist, October 12th, 1957, page 157.

The Rhodesian producers proposed a common price which had to be related to the LME quotations, but would change less frequently and that the timing and extent of the change would be decided by the producers. The option of the consumers were basically three: to continue with the dual price system which they considered unsatisfactory; to accept the proposal of the Rhodesian producers for a producers' price; to return to the open market basis. The latter was the most accepted by the consumers since it offered the lowest price and did not require producers collusion (1). To the system proposed by the producers' the consumers suggested a series of amendments which were rejected by the Rhodesian and the Negotiations broke down.

In this situation the Chairman of RST publicly declared that about two-thirds of the market economies production was in the hands of a few large companies and he asserted that they should accept the responsibility which goes with size and be ready to control the supply at source rather than continue a policy of full production and diminishing prices. He asked the producers to accept a voluntary 10% cut back which RST was already implementing. He added that lower prices were not necessarily going to squeeze the high-cost mines: many such mines were of such importance to their countries that some means of keeping them in production would be used (2).

This was a concrete appeal for concerted action to the other leading producers, but this collusive agreement was not to materialize until a few months later.

As the prices declined, British consumers pressed RST to change its policy and to fall in line with Anglo American. In October 1957 RST abandoned its practice and adopted the LME as its pricing basis (3).

RST had failed to obtain support from its rivals and the price had not been stabilized. Despite that it began to use again the same basis as Anglo American to set the price of copper; the other oligopolists did not change theirs. At the prevailing price level of less than £220 a ton substitution was not a threat in any market, but this was the result of the recession and the uncoordinated decisions on production of the suppliers of the international market.

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(1) The Economist: November 23rd, 1957.

(2) The Economist: September 21st, 1957, page 969.

(3) The Economist: October 12th, 1957, page 157.

However, at that time, second semester of 1957, RST was still persisting in its principal objective, to stabilize the price of copper but it was trying to adapt its policy to the new market conditions.

#### 6.1.2.3 The producer's collusive agreement of 1957-1966.

In 1957, the suppliers of the international market were using the basis already analysed to set the price of copper; RST adopted the LME as a base for its prices in October.

The LME quotations fell gradually but persistently from 56 cents in March 1956 to 20 cents in February 1958. The average cost of production of the leading copper producers ranged from 17½ to 25 cents a pound in 1957 (1). In the U.S., the tariff on copper had been suspended since the Second World War, but was re-established during the slump at a level of 1.8 cents a pound, so equivalent to 7.8% of the average LME quotation of the last quarter of 1957: it could be expected, therefore, that the import reduction of the U.S. was to be diverted to Europe.

The causes of the prices decline were the recession affecting the market economies more drastic in the U.S. than Europe: production from new mines controlled by the leading producers was reaching the market: and the Chairman of RST, R. Prain, added as a secondary reason, the absence of strikes (2). The latter were going to have an important role during this experience.

Negotiations between the copper companies took place in the third quarter of 1957, but agreement was not reached (3). The same factor which prevented an understanding in the 1930s influenced the outcome of these negotiations: new production capacity during a market slump. Although the 1957 recession was relatively small, in comparative terms, there was no producers powerful enough to impose discipline among the rivals. Despite the fact that the subsidiaries of Anaconda and Kennecott in Chile had complete control of their operations, they were constrained by the reaction of both government and public opinion in Chile and the possible application of anti-trust legislation in the U.S. Although these companies were the largest suppliers, neither in 1957 nor in the five next years, did they ever take a publicly known initiative in the international market. The only

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(1) The Economist, December 14, 1957, page 999.

(2) The Economist, November 23rd, 1957, page 701.

(3) The Economist, December 14th, 1957.



suppliers who could take a leading position were the Rhodesians, but they had disagreed in their price policies for the last two years; only in the second half of 1957 could they define the basis of an understanding; the firm more committed to the definition of a common policy was RST. Other suppliers of the international market, namely the Belgian Congo and the Canadians, were too small and had not the same connection with the U.S. producers as the Rhodesians had.

Apart from the corporate connections, the two Rhodesian companies had ~~two other~~ factors in common. Their average cost of production were in the high range among the suppliers in the international market (1), so both of them were being more affected by the recession: moreover an important part of their output came from underground mines whose variable cost represents a significant part of total cost, so that the effect of an eventual production curtailment was more favourable than in the case of producers with open-pit mines. However, the two companies had important programmes of investment. A total increase of capacity of 150,000 tons was expected for the second half of the 1950s: most of these projects had been undertaken by Anglo American and the two companies were competing for the same markets.

In June 1957, RST announced a 10% cut of production: Anglo American declared that they were affected by an involuntary cut of 10% due to the technical problems in Bancroft, a new copper mine of the group.

In December 1957, there was another negotiation among the leading copper suppliers: prices were below the average cost of some producers. After this meeting, Kennecott announced a 12% curtailment of its U.S. output (2).

In January, the Chilean and the Belgian Congo producers met the RST (3): in the U.S., other copper suppliers followed Kennecott. In February Anglo American announced a reduction of its planned output for 1958: its decision was to suspend production in Bancroft, its highest cost plant, but to increase the output of Rhokana and Nchanga, its lower cost mines; the net effect was an increase of 5% relative to its 1957 output (4).

Early in 1958, the symptoms of economic recovery started to be felt in the U.S. The Chairman of Anaconda announced that copper consumers were

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(1) The Economist, December 14th, 1957.

(2) The Economist, December 21st, 1957, page 994.

(3) The Economist, January 18th, 1958, page 242.

(4) The Economist, February 1st, 1958.

requesting copper for immediate delivery: almost simultaneously, Phelps Dodge announced a further cut of 5% in the U.S.: this measure was in apparent contradiction with the announcement of Anaconda, but it was not really as will be seen.

In March, the prices of copper began to increase from their lowest level of February (1).

In the second half of 1958, a wave of strikes began lasting 7 weeks in Chile, 7 in Northern Rhodesia and 4 in Canada. These and other conflicts of different magnitude were the first of a series which took place along this period, in most of the cases just when the specialized press was arguing that prices would fall if no additional curtailment were decided. It does not follow that the companies were using the highly risky method of provoking strikes to reduce production, though it is possible that some companies adopted it. Only because the following statement reflects how a strike affected the position of a company during this period, ~~not~~ by any means suggesting that RST adopted this method, the comment of its Chairman is quoted "RST suffered very small losses from the 52 days' strike on the copper belt in the last quarter of 1958, the real losers were the employees because the leaders of the European mine-workers could have reached substantially the same settlement of the dispute without strike". And he added that the RST mines were able to sell from stock, at prices that were inflated partly by the strike, and the stocks were to be fully re-built before the current financial year ended on June 30th" (2).

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- (1) Despite the fact that this study does not deal with negotiations which did not take the form of a market action, it is important to note that in April 1958, the Chilean government requested the implementation of a mechanism to stabilize the price of copper to the UN International Trade Commission (The Economist, Ap.26, page 346). In May, J. Lagarrige, representative of the Chilean government proposed a scheme to stabilize the price of copper to the International Wrought Non-ferrous Council, organisation of the semi-manufacturing industry of the industrialised countries, except U.S.: the plan was rejected by this Council: the communique stated in this respect that "the interest of copper could best be served by leaving the industry free" of intervention (The Economist, Ap.26, 1959, page 58). A few months later, September, the UN Conference in Copper, Lead and Zinc, met in London. The possibility of governmental action on copper was rejected it was agreed not to set up a working group to deal with copper. (The Economist, September 13, 1958).
- (2) The Economist, January 17th, 1959, page 249 and The Economist: Company Affairs, Copper Profits, February 14th, 1959, page 634.

After these strikes, production cuts were suspended by the suppliers of the international market: prices had reached almost 30 cents, a level at which, according to the statement of the Chairman of the leading companies, there were no threat of substitution. The coordination of suppliers of the international market had considerably improved in less than one year prices had increased by 50%; a favourable factor was that copper consumption had been increasing in the market economies. However, the system of coordination still had weakness. Late in 1958, Union Miniere cut its price below those of its rival. Partly as a result of this action, the LME quotation experienced a reduction of 2.5 cents in December (1). No retaliatory action was adopted, but negotiations took place.

In 1959, the output surplus was absorbed by consumers and speculators who were influenced by the possibility of a strike in the U.S., when the wages contracts expired in June. There was a strike in one of the Chilean companies and another in Canada, International Nickel Co. this time (2). The suppliers of the international market re-established curtailment (3) but these were suspended when the strike began in some of the copper companies in the U.S. The conflict lasted about 6 months and the total production loss was estimated at 300,000 tons, 12% of the market economies consumption (4).

In 1959 the LME price fluctuations were less than 5% respect the annual average. It is likely that in the absence of producer agreement, the variation would have been greater.

In 1960, the output of Toquepala, a mine brought into production by Southern Peru, began to arrive on the market. being equivalent to about 1% of the production of the market economies. The main shareholders of that company, ASARCO, had only a small copper mining in Australia and another in the U.S. In real terms it was a newcomer: Phelps Dodge an important minority shareholder of Southern Peru had no other interest in copper mining outside the U.S., and therefore, it was also a newcomer.

The analysts of the copper industry suggested the possibility of an outbreak of producer indiscipline and that an important surplus was to appear during that year: prices were weakening in the Exchange. supporting the argument of the analysts.

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- (1) The fall of the LME quotation was also caused by an announcement of the U.K. Board of Trade that it would sell about 10,000 tons of copper.  
 (2) The Economist, January 30th, 1960, page 457.  
 (3) The Economist, July 25th, 1959, page 242.  
 (4) The Economist, August 22nd, 1959, page 567; February 20th, 1960, page 748.

The Chairman of Anglo American defined the policy of the producers: "Such a situation (of surplus), if it comes about, would be met by an appropriate reduction in supply by the leading producers" and he added that "the knowledge that producers would act in this way is a factor for stability in the market"(1).

This obviously implied that producers were concerting their actions and had decided to accept the newcomers.

The non reaction to a new entrant by the suppliers of the international market can largely be explained by the fact that Phelps Dodge owned 10% of RST and had connections in South Africa with the Anglo American group: moreover ASARCO and Phelps Dodge played an important role in the U.S. where Kennecott and Anaconda were the leading companies. Moreover, when the producers cut production in 1957 Phelps Dodge announced an additional 5% curtailment: the same decision had been adopted by ASARCO.

In 1960, strikes were expected in the U.S., Chile and Northern Rhodesia, only in Chile did they materialise but lasted a relatively short period.

In October the Rhodesian announced restrictive measures, RST an outright cut of production of 10% and Anglo American a reduction of its sales by 10%, adding that its operating companies could, from time to time, determine whether the reduction was done by cutting output or holding copper in stock. Noranda met the cut. Some producers like Union Minere de Katanga and the companies operating in Chile required more time than in the past to adopt such a decision. The former declared through a spokesman that any such steps which would interfere with the revenues of the government of Katanga would have to be referred to the government (2), of the recently independent nation: a spokesman of the Chilean companies declared that they thought that the government would not accept a cut back. But the decision to cut back was nevertheless implemented. An additional measure was adopted in this situation by at least one company, RST, which began to support the LME through purchases in October 1960 (3). Only at this point, it became clear that the producers were supporting a price of nearly 30 cents per pound, a level around which the LME quotations fluctuated in 1960.

(1) The Economist, June 11th, 1960, page 1128.

(2) The Economist, October 8th, 1960, page 172.

(3) In 1957, reports on the copper market suggested that the primary producers were buying copper in the open market, but this is unlikely; producers had not agreed in production curtailments but in the market conditions of that year that type of operation did not make any sense without output restrictions. In 1958 and 1959 analysts made again the same comment, but the statements were not supported by any evidence.

In the U.S. the domestic producers' price fell to 29.6 cents in the last quarter of 1960. In January 1961, all producers, except Kennecott cut production: five months later they raised the price to 30.6 cents and announced that they were to maintain it for the remaining part of the year.

For the first time since 1953 there was only one producers' price in the market economies; the measure adopted by RST, possibly supported by most of the leading producers, can be explained by the fact that speculative pressures had been operating against the producers' price causing a reduction of the forward quotation of the LME; if this step had not been taken, additional curtailments were the only alternative producers option. These operations were also supported by expectations of strikes and minor labour conflicts in different countries, the most important of which was again in Chile where the producers had to declare force majeure in August.

In 1962 production curtailments were maintained but before the summer the Rhodesian producers and Noranda announced an additional cut of 5% to avoid the accumulation of stocks during this period. Minor strikes affected production. In the U.S., Kennecott still had not restricted its output, but it announced that it would be prepared to join others in further cuts if necessary (1). In April, the LME spot quotation stuck at 29.25 cents and remained constant until December 1963. International Nickel had been regulating stocks since 1959, but in October announced a production cut by 13%.

In 1963 the situation did not change too much from that already described. The producers operating in the LME began to buy an amount of copper offered to them over a period of 12 months. Most of the copper they absorbed came from refined scrap and the unwanted residues of long term contracts. Speculative operations had already been defeated. Stocks outside the U.S. did not experience important variations. The two months strike at Hufulira was the only important conflict, but helped to keep in balance supply and demand. The prices of copper for the fifth consecutive year were the most stable that the copper industry has ever had without governmental control.

The collusive agreement lasted another three years, but operating under different market conditions. It is necessary to make some general considerations concerning the agreement.

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(1) The Economist, June 16th, 1962.

In 1958-63 consumption and capacity of production were increasing; the fact that the market could absorb part of the new capacity of production was a favourable factor to the success of the policy implemented by the producers during six successive years.

The curtailments of production were always announced in percentages which were possibly applied either on capacity which was expanding or the programmes of production for the period. Some companies reduced production while others restricted sales. These situations did not permit the determination of the extent to which the announcement were respected, however, the system was successful, in that, prices first increased and did not experience important variations after reaching the level that the producers chose. It is noted that the firms did not set up a system of control as the cartels which operated in the inter war period did; the method adopted revealed a great deal of mutual confidence among the producers giving more flexibility to the system.

The objective of the policy was the stabilization of the price of copper, but this was not an aim per se; in those market conditions the alternative to a cooperative producer scheme was a lower price for copper and possibly for a longer period if the producers lost control of the stocks. The possibilities of substitution must have played an important role in the decision on the level at which the price was to be stabilized, but this was not the only factor considered as some analysts of the copper industry have suggested (1). The control of the rate of expansion of producers other than the leading companies must have been an important consideration as well as the reduction of the possibilities of new entries. The former as a result of the reduction of the market share of the four larger producers, the latter because the Japanese were "investing large sums in foreign mining enterprises abroad to ensure supplies of raw materials"(2), copper was a commodity that these investors were considering as a possible field of investment; moreover, the Japanese had doubled their smelting and refining capacity, despite the fact that their domestic copper mining output remained constant. In terms of volume the expansion was not significant,

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(1) See for instance: Peter Bohm: Prices of Copper in International Trade. A case study of price stabilization. EFI. The Economic Research Institute at Stockholm School of Economics. Stockholm 1968.  
D.L. McNicol The Two Price Systems in the Copper Industry. Bell Journal of Economics, Vol.6, No1., Spring 1975, pages 50-73.

(2) The Economist, July 13th, 1963, page 173.

about 200,000 tons (1), but it represented an important inroad in the market share of the vertically integrated dominant suppliers; the Japanese were an important threat of possible expansion in processing and entry in copper mining overseas.

In November 1963 representatives of the copper companies and the Wrought Copper Council met in London and studied demand prospects for the next year. It was estimated that no important changes in consumption were going to take place.

In February 1964, the LME quotation began to rise; stocks held by producers were not large enough to meet additional demand. Anglo American and Roan Selection Trust announced they were going to continue selling copper at 29.3 cents per pound (£236 a ton) to avoid substitution.

Union Miniere de Haut Katanga and the companies operating in Chile met the price of the Rhodesian producers. The U.S. domestic producers' price did not vary, although that it was lower than the international producers' price if transport and tariff were included.

From January 1964 to April 1966 there were 6 changes in the international producers' price and 4 in the U.S. The LME quotations were always at higher levels.

The first movement was announced by the producers collectively in March 1964. The price was raised to 30½ cents, while the LME cash quotation was about 34 cents. In the U.S. ASARCO increased it to 32 cents, and all producers followed.

In August, Anaconda and Kennecott increased its non U.S. price to 32½; according to press information it could not resist the pressure of the Chilean government which was facing a presidential election campaign; other producers followed again. The LME cash quotation was 45 cents but the forward price was higher. The U.S. producers' price was increased to almost 34 cents.

In November, the Chilean government pressed Anaconda and Kennecott to raise the price to 35 cents. Neither the suppliers of the international market nor the U.S. producers modified their prices.

In May 1965, the price was again increased in Chile, by one cent; the African suppliers raised their prices from 32½ to 36 cents. The U.S. producers fixed the same price.

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(1) Estimated on the basis of the imports of concentrates.

In October 1965, the Chilean producers increased the price to 38 cents, and they were again followed.

In November most of the U.S. producers raised the price to 38 cents but the increase was rescinded after government insistence.

In January 1966, Union Miniere de Haut Katanga increased the price to 42 cents. All the suppliers of the international market met the new price while the U.S. domestic producers' price remained unchanged. In April 1966, Chilean producers put up the price to 62 cents. The African suppliers decided to sell their copper on the basis of the LME forward quotation. Canadian and Chilean producers also abandoned the producers' price policy.

During this producer price policy four of the six price changes followed by all the suppliers were led by Chile, one by Union Miniere de Haut Katanga and the other was a collective decision. During the whole period there was constant pressure by the Chilean government to raise copper prices. This situation can be explained by the determinant role that the flow of foreign exchange plays in the economic policy of a country whose exports consist of basically one product.

But the Chilean government pressure does not explain why the producers' policy was abandoned. Two other factors were determinants. The Government of the Democratic Republic of the Congo had not yet announced publicly its commitment to nationalize the Belgian copper company, but their relations did not promise an easy solution due to the political development at that time. Therefore a policy based on short term objectives was adopted. The second important outcome was that in October 1964, Northern Rhodesia became independent. The companies required a definition of policy with respect to their status and decided to test the attitude of the government by asking for a change of the tax system applied to the copper industry.

#### Summary and Conclusions

In 1955-64 the U.S. copper consumption increased at a lower rate of growth than in the other market economies. An increasing amount of the copper production of Canada and Chile had to be diverted to Europe, affecting the traditional suppliers of this market.

In the earlier part of this period, for the first time since the Second World War, the companies supplying the international market were operating without direct intervention of the governments of the consumer countries. The producers had different bases to set the price of copper, though their



quotations were similar, there was a risk that they could diverge, since they had not coordinated their decisions for a long period of time and it would seem that they had not defined a common mechanism they could refer to their policies.

The two largest suppliers in the market economies, Anaconda and Kennecott were unable to play a leading role in the international market, on one hand due to their dependence on the reactions of the Chilean government and on the other hand for a possible application of anti-trust legislation in the U.S.; any type of initiative had to be adopted by the Rhodesian producers; Union Miniere was too small and had not the corporate inter-relation with the American suppliers the Rhodesians had; the Canadians were also too small and the whole output of one of them was a by-product of nickel.

The LME quotations could be a mechanism of oligopolistic coordination; but to set the price on that basis would have implied that neither the threat of substitution nor the possibility of new entries to the international market were taken into account.

Two producer price policies were adopted in this period; both of them had in common that the publicly known objective were to stabilize the price of copper and to help prevent substitution. In both of them Roan Selection Trust played the major role: it was not followed by its rivals at first, but it gained their support later.

The first experience took place in 1955-57. Although the threat of substitution affected all the market economies, the decision adopted seems to have been influenced by the particular conditions prevailing in the U.K. semi-manufacturing industry, the relevant market of Roan Selection Trust. Second, studies of the market conditions made at that time concluded that the period of high copper prices was not going to last very long and was caused by delays from some of the new mines or capacity expansion projects in starting up operations. Third, some of the major producers had also invested in new mines and expected a price decline so they considered it better to recover part of their financial commitments by exploiting the prevailing market conditions.

When the price trend reversed the only producer who decided on curtailment was RST, and it took about six months to the other leading companies to meet the output cut of that firm; in 1957 supply over ran demand and producers indiscipline depressed prices, which approximated to the average cost.

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The second experience began in 1958 and not in 1960 as some analysts of the copper industry suggest. This common mistake is possibly due to the fact that first, the curtailment were suspended in 1958 after the strikes in Canada, Chile and Northern Rhodesia but they had absorbed the expected surplus of that year: second, in 1959 there was another strike in the U.S. which had a similar effect: but before this conflict, curtailments were reimposed and suspended when the strike began; so there was continuity on the policy of the companies.

This experience has been the longest collusive agreement in the international copper market, nine years; possibly, it was also one of the most successful. A factor relatively favourable to the producers was that copper consumption was expanding.

The most important mechanism adopted by the producers to stabilize the prices of copper were restrictions of production and/or sales in 1958-63; direct purchasing in the LME and possibly outside the exchange in 1960-63. In 1964-66 the operation of a producer' price whose level was lower than the LME quotations.

In 1958-63, strikes played an important role as a mechanism to absorb surplus: unfortunately, at an international level the information about these conflicts is poor; more research would be necessary to define more precisely their role: it is likely that such additional information may change evaluations and judgements made by some analysts on the basis of national contexts. However, it can be said that when price stabilization is a common objective of the producers, it can be expected that more consideration is given to the cost, and conflicts between the companies and the unions of the copper industry are likely.

In 1958-63 the producers gradually approached to the same base to set the price of copper and their decisions became more coordinated: this made it easier to continue for another three years when the market conditions reversed to another of deficit, in 1964.

In the earlier years, the price of copper was increased by 50% and in the later years the price was stabilized at a level at which there was no threat of substitution and reduced the possibilities of expansion of the marginal producers and new entries into the market.

Price fluctuations were lower than 6% compared to 17% for 1953-1970.

The policy permitted and allowed the entry of a new mining producer (or a new supplier of the international market), ASARCO. But the project of investment had been decided in 1955, before this experience began.

It was not possible to compile information on the profitability of the firms involved in this policy; however, the reports to the share-holders of the two Rhodesian producers, as summarized by The Economist, reflect that the position of both companies in 1959-63 considerably improved with respect to that of 1957. This is obviously not general but one index. However, it can be said that the reduction of cost per unit resulting from the operation at full capacity by all the producers is unlikely to have compensated for the reduction in prices: this is without taking into account the depressive effect on price that the accumulation of stocks by the consumers has on the prices.

In 1964 demand could not be met by supply and to avoid substitution and new entries, producers decided to maintain the prices at lower levels than the LME. The Chilean government, an agent not directly involved in operational activities but extraordinarily affected by their results, determined most of the price increases.

The policy was abandoned in 1966 and all the major exporters adopted the LME quotations as the basis of their prices.

Another factor had become determinant in the behaviour of the Central African suppliers; these companies were facing uncertainties <sup>with</sup> respect to their relations with the host governments of the two new nations, Zaire (1960) and Zambia (1964), short run rather than long term considerations became more important; moreover, negotiations were to affect their parameters and so the basis on which a company plan its operations. It is likely that the companies had preferred to concentrate their efforts on the negotiations with the governments which, without doubt were to change the rules that the Colonial Authorities had approved. At that time negotiations were taking place in Zaire and they were becoming increasingly difficult due to the political developments in this country.

## 6.2 The period 1966-72

The most relevant characteristics of this period were the changes in the structure of the cooper industry which affected the patterns of trade and the behaviour of the participants in the market; the price basis adopted by the producers, i.e. London Metal Exchange quotations, and the failure to

adopt a mechanism of coordination among producers which resulted in the market becoming more competitive.

There is not a simple cause that determines the lack of cooperative behaviour during this period; the changes in structure were important and also political issues related to the copper industry in developing countries.

The difficulties in agreeing on a common policy did not make it possible to replace the price basis adopted by producers despite the long-run implications.

The analysis of the process is complex due to several variables intervening in the period. To integrate it, the following general scheme was adopted: 1) Marketing characteristics. 2) The London Metal Exchange 3) Oligopoly when the parameter of action is output, some general considerations. 4) The process of nationalisation. 4.1) An analysis by countries. 4.2) Nationalisations: changes in the structure and behaviour, a general appraisal. 5) The market conditions in 1966-72. 6) Other changes in structure and the strategies of the private copper companies and of the copper consuming countries. 7) Evaluation.

#### 6.2.1 Marketing characteristics

Copper is directly sold by the primary producers to either custom smelters or the final users. But due to the lack of vertical integration of the producers which sell in the international market, the process may take several forms. First: concentrates can be sold directly as such or be treated by a custom smelter on a toll basis; in the latter case, the mineral is sold as refined copper by the same primary producers or one or more of its agents. The relation between a large, primary producer and his custom smelter rests in long-term contracts, 5 to 10 years.

Copper concentrates are paid for at the market price, less the cost of treatment and remuneration to the capital of the custom smelter. The contracts are relatively complex and present variations from one case to another. They usually include cost escalation clauses (the charge of the custom smelter is adjusted according to cost variations) and a further premium for precious metal content and penalties for impurities such as arsenic, tin, etc. The contracts also contain a participation clause by which the producer makes an additional payment when the copper price is above a certain level e.g. 10% for each cent above 65 cents per pound.

Second, the producers smelt their copper and sell it either as such or refine it on a toll basis in a custom smelter. This pattern has become less important because the amount of blister copper sold in the international market has remained almost constant in the last 15 years while the total trade of copper has grown at a rate of 4% per annum. The relation between a custom smelter and a seller of blister is also reflected in long-term contracts, usually five years; the price paid is equal to the market price less treatment charges. The contracts also contain premiums according to the purity and precious metals and penalties for the impurities, as well as a cost escalation clause.

Third, integrated producers with a refinery may sell their copper as fire refined, cathodes or wirebars. The first of the three categories mentioned became less important in the late 1950s due to the fact that purer copper was required by modern technology, while cathodes have become more important after the energy crisis; most semi-manufacturers installed continuous casting equipment directly melting the cathode into rods, thus avoiding several intermediary steps in the process of production. Refined copper is generally sold on an annual basis and the price is set by the consumer according to the modalities considered later.

Conversely, consumers (final users) or semi-manufacturers of copper may be integrated backward owning either a smelter or a refinery; in this case they buy concentrate or blister, respectively, another possibility is that consumers and/or merchants buy concentrate or blister and treat them on a toll basis.

It can be generalised that copper is directly traded between primary producers, custom-smelters, semi-manufacturer or final users. The volume of metal traded in the international market and its values are such that it is more economic to avoid intermediaries. As a rough estimation it can be suggested that only about 15% of the copper traded in the international market passes through intermediaries.

The contractual bases that regulate the relations between producers and consumers are relatively standardised but several clauses depend on the negotiations between the parties. Each contract specifies the type of product, the annual quantity to be supplied in the period, the number of shipments, the amount of each shipment, the conditions of payment, the currency in which the payments will be made, and the modality by which the price will be determined.

### 6.2.2 The London Metal Exchange

The London Metal Exchange (1) is one of the two important metal exchanges operating in the world. Five metals are traded in its ring, silver, zinc, lead, tin and copper (2). Each metal is traded in four opportunities for five minutes each day. The official price corresponds to the last transaction of the second ring.

Copper is the most important metal traded in the LME, both in volume and value. There are two separate quotations, one for wire bars and another for cathodes. But each of these products is quoted on a cash (for immediate delivery) and a forward basis (for delivery up to three months from the date of contract).

When there is a copper surplus, the forward price is higher than the cash quotation, the difference between both prices is known as a contango which is equivalent to the current rate of interest and the cost of maintaining a given amount of copper in stock.

When copper shortage exists in the market the inverse situation occurs, the present value of copper is higher than the price of copper in the future.

The difference between both prices is known as a backwardation and it does not have a limit as in the case of the contango.

In the international market most of the copper is directly traded on a contractual basis for a period of at least one year and does not pass through the LME. This is a marginal market, where the different participants can offer their surpluses or buy their deficits of copper.

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- (1) For a detailed description of the organisation and operations which take place in the LME see: Robert Gibson-Jarvie "The London Metal Exchange, a Commodity Market" published by Woodhead-Faulkner Ltd. and Metallgesellschaft A.G. The Financial Times Survey, February 16, 1977 "London Metal Exchange" pages 15-30. Financial Times Survey, October 28, 1976. "London Metal Exchange", pages 33 to 36. London Metal Exchange "The London Metal Exchange" January 1974.
- (2) In October 2, 1978, the LME started future operations on aluminium. For several years the authorities of the Exchange had unsuccessfully negotiated to start trading this metal: the main opposition came from the producers who have maintained for several years a relatively stable price: one of the main public arguments has been that the LME's operation would be a threat to the price stability due to speculative dealing. (See Financial Times, October 3, 1978, page 30). In 1979 the LME also started to quote Nickel.

The mechanism permits that producers either directly or indirectly to reduce the cost of carrying excessive stocks or of reducing production. It is also a system by which occasional or marginal consumers can obtain their copper more cheaply than through any other alternative mechanism. It is also used by semi-manufacturers, merchants, or any other agents, who want to adapt their level of stocks to the changing market conditions.

The Exchange operates like any other marginal market: if its prices do not reflect the general conditions of the market, a positive (negative) flow of stock will be carried to (be taken from) the London Metal Exchange and prices will orientate towards the new conditions.

Therefore, the prices of the Exchange reflect the differences between supply and demand which takes place in the market.

But like any marginal market, it is very sensitive to real or expected changes in the market conditions. An abnormal market situation could be over compensated and the orientation of prices towards equilibrium could well take a relatively long period: the duration of the adjustment will depend on several factors such as the initial situation, expectations, changes in demand and supply, etc.

The character of the Exchange, the mechanism by which it operates and the sensitivity of commodity prices to changes in the economic situation, have determined that this market has always been a rich field for speculation. This has always been a subject for long discussions about the magnitude, effects, and implications of this type of activity; but agreement has never been reached because it is difficult to define who the speculators are, thus making it impossible to assess the magnitude of their operation. Despite the relevance of this subject, here it will only be noted that the effect of speculative activity could be to widen or to reduce the magnitude of price variations and to delay or accelerate the period of adjustment.

It can be said that the LME prices reflect the general conditions of the market, considering a period of time of variable length whose durations depend on the prevailing situation.

Given this characteristic, the relevant problem is whether producers have to follow blindly the prices of the Exchange whatever the conditions, as they actually did from 1966 on. The question arises why the producers have behaved in this way and whether there is an alternative. It is intended to answer this through the analysis of the industry during this period.



The three basic functions of the LME as far as copper is concerned, are:

- 1) It is a physical market. Any person can sell or buy copper through one of the dealing members. Semi-manufacturers and consumers can use it to buy their deficit requirements or to sell their excess of stocks. But the LME is not important as a physical market when compared with the total volume traded in the international market, well under 10%.
- 2) It is a hedging market. Buyers and sellers of copper can protect themselves against risk of loss originated by price fluctuations through hedging.

The mechanism of hedging is relatively simple; the physical operation of buying or selling metal is accompanied by the reversal operation in the LME, so that the possible loss due to price variation in one of them can be compensated by gains in the other.

A simplified example can illustrate this mechanism: a semi-manufacturer buys a physical amount of copper at the settlement price to supply the requirements of a client, he will set the price of his product on the basis of the LME copper quotation prevailing at the moment of delivery. If the copper price falls he will make a loss but will benefit if the price increases. To reduce uncertainty he sells forward the same amount he had already bought.

At the time of delivery he sells the semi-manufactured product and at the same time closes its operation in the Exchange by buying at the settlement price the amount he had already sold forward. Whatever the direction of the price movement the semi-manufacturer has gained in one of the transactions and lost in the other, but reduced the effect of the price fluctuation (1).

Hedging operations as such are much more sophisticated, taking also into account monetary variations as well as the differences in the rate of interest prevailing in European countries, but the principles defined above are basically the same.

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(1) Examples of this type of hedging can be found in M.S. Brown and J. Butler: *The Production, Marketing and Consumption of Copper and Aluminium*. Praeger Inc. 1968. F.E. Banks: *The Economics of Natural Resources*, pages 141-177. Plenum Press, 1976. F.E. Banks: *The World Copper Market: An Economic Analysis*. Ballinger Publishing Co., 1974.

It must be noted that not all semi-manufacturers or consumers use hedging operations to the same extent. The author was told for instance that the French hardly use this mechanism while it is more widely used by German, British and Japanese fabricators.

3) The third function of the LME is as a basis for the price of the copper traded in the international market. As was pointed out before, the contracts between copper producers and consumers define the form by which the price of each shipment will be set. The modalities may vary from one consumer to another, but they can be classified into two groups.

First, the price is determined as an average of the copper quotations of two or more days. Usually it is the average price of one month, which may be the month prior to the shipment, in the month of delivery, or in the month of arrival.

The second seems to be the more common for refined copper. The client fixes the price according to contractual rules. The client has a period of time to set the price of copper: producers have agreed to reduce this period to a month.

There are limitations to the proportions of the shipment at which the buyer can set the price based on one quotation of the LME.

For instance, the consumer cannot set the price for less than 12.5 and not more than 25 per cent of the shipment in the first week, to not less than 25 and not more than 50 per cent in the second week, and so on, until the price of the whole shipment is determined.

Generally, the contracts establish a system based on the known price, that is, the consumer fixes the price based on the official quotation of the previous day but before the first ring of the following day of the LME.

#### 6.2.3 Oligopoly when the parameter of action is output, some general considerations

Before 1966, the suppliers of the international market simultaneously made the output price decisions: the resulting producers' price, allowing differences for quantity and transport considerations, were basically the same in the international market.

The relation between the producers' prices and the LME quotations had different patterns in time, but when considered over a period longer than one or two months, they followed the same trend. Some analysts have stated that the prices set by the suppliers of the international market followed those of the LME. Here it will be said that the LME quotations reflected

the overall market conditions, including the output-price decisions of the producers who in turn re-evaluated them based on the information from the exchange. Speculative price movements or sporadic *désequilibria* in the LME did not result in changes of producers' prices.

The adoption of the LME involved more than a formal change in behaviour of the producers: that they began to act in terms of output and the price was not any more a parameter of action of the firms but their decisions continued having a significant influence on the prices due to the moderately high output concentration in the 7 largest producers.

However, many other questions which seem important arise. Does the new mechanism of operation limit the capacity of response of the producers to the moves to their rivals? What effect does the new mechanism of operation have on the producers' interdependence? Does the new behaviour affect the possibilities of reaching a collusive agreement? Does the industry become more competitive?

In pure oligopoly when the producers set the price of an homogeneous product the possible reactions of the suppliers to the price reduction of one of their rivals are several: they may meet the price reduction to restore their market share; they may undercut the price reduction either to teach discipline to the price-cutter or to recover business they have lost; they may even maintain their price if they assume that the rival was wrong or when the price-cutter is relatively small and its possible market share gain does not affect the leading producers.

In an oligopolistic industry where the parameter of action is production, the effect of an increase in output by one of the suppliers, other factors constant, is a reduction of the market price; the impact on price varies in direct proportion to the increase of production respect to the size of the market and in inverse proportion to the market elasticity of demand. In the absence of rival response, a small firm will have a greater incentive to increase its output than a larger producer, because its individual demand is much more elastic and the effect on price smaller.

In this type of oligopoly, if one producer increases the sales of an homogeneous product he reduced the market price and the income of his rivals but he does not necessarily take physical units away from his competitors' business while there is no response of the other suppliers. In oligopolies where the parameter of action is price, a price cut causes a drastic reduction of his rivals position if they do not meet his price. However, when the variable is output, if the rivals want to maintain their

market share, they necessarily cause a greater price reduction than that caused by the firm which made the original move, a result which does not necessarily follow in the other case.

Let us analyse a simple arithmetical model which helps to clarify some of the possible effects of the potential moves of a group of few rivals which act in terms of output rather than price. Let us assume an industry whose market demand at the current price is 100 units of an homogeneous product and that only three firms supply the market; firm 1 controls 60% of the output of the industry and firms 2 and 3 control 30% and 10% respectively. It is also assumed that the price elasticity of demand is 0.3 within the relevant range of price variations and that the marginal costs are constant. The initial market price is 70 monetary units.

If firm 3 increases his output by 20%, he drives the price to 65.3 but his total revenue increased by 12% respect his original situation while the income of the other two suppliers fall by 6.6%

If the two affected firms do not collude, the broad possible responses of each one are (a) to restore their market share; (b) to reduce their output to sustain the former price or (c) do nothing. Each of these moves has important implications.

Let us consider alternative (a) but first analysing the case in which only firm 1 decides to recover its market share, assuming other factors constant. The output increase would result in a reduction of the market price to 59.1 and the revenue of firm 3 would still be higher than before its move, while firm 1 revenue would be 11.4 below its original position, that is, lower than before it responded to firm 3's move. At this stage firm 2's position is the most affected in terms of revenue, so it can be expected a new increase in output causing a further reduction in price.

If successive output increases continue until the original market share of all the producers is re-established, the price and total revenue of the industry would fall to 30 units and to about 51% of its original level.

In alternative (b), assuming that firm 1 decides to maintain the original price by reducing its output, firm 1's revenue would fall by 1.7% and its market share to nearly 59%. In this case, the market position of the firm which made the original move would be the best of all the alternatives under consideration. The immediate effect of this option, from firm 1's point of view, is that increase its income above the level from which was after firm 3 made in the first move, however, in a longer period the implication of this strategy may be different because it stimulates other suppliers to increase their output or to firm 3 to repeat its action.

Alternative (c) (do nothing) from firm 1's point of view has the same disadvantage, it also encourages other firms to enlarge their output, but at a lesser extent than in alternative (b).

It seems that when the parameter of action of the oligopolists is output, the producers do not have a possible retaliatory response to competitive moves less expensive than that which the oligopolists have when the parameter of action is price, to meet the price reduction of the cutter.

To return to the initial point of the analysis, it is possible to define some of the alternatives available to a producer who intends to increase its output when it takes into account the possible responses of his rivals. The less favourable response he can expect is that in which the rivals try to restore their original market share but this strategy is also the most expensive to those who implement it. The other possibility is to act in such a way that the largest firms accept his move without reaction, that is, increasing output with moderation so he can hope that the rivals will not retaliate; there is not a definite line which defines what will be accepted and what will be refuted. But it is noted that the policy of moderation may be adopted by all the producers and the effect on the market price may be considerable, specially when elasticity of demand is relatively low in the short term. Within these two extreme possibilities there is an indeterminate number of intermediate possible responses of the rivals: this fact also suggests that the possibilities that the rivals act as a group to his move without explicit collusion are relatively unlikely.

The indeterminate solutions of oligopoly are also found when output is the variable. However, it seems that competition among the few tends to be more intensive than when the firms make simultaneously the output-price decision. It also seems that to raise the price above the competitive level explicit collusion would be necessary, a solution which is not always needed when the producers made the decision on both variables.

Finally two other situations will be considered. The first, how the producers do react when demand increases and there is a shortage of supply. If the parameter of action is output and the price is set in a marginal market, as in the case of the copper industry, the effect on market price is obvious. To obtain their additional requirements the consumers use the marginal market. If stocks are relatively low, independently of the

action of the speculators, the prices will increase and if the shortage persists prices will run out of control of the producers unless the oligopolists collude and/or change their behaviour. To control the price variations the producers may sell copper in the exchange but to be effective such a measure would also require collusion because this is a risky operation to be borne by only one producer or several producers acting independently. Moreover, if it is only practiced by one producer or without coordination, those involved have to practice order backlogs so they face the risk of losing consumers when the situation reverses and that the measure becomes ineffective because those consumers affected by supply curtailments may also use the exchange to obtain those requirements. When price is the parameter of action of the oligopolists the producers have several alternative responses but in no case will the price run out of their control.

The second situation, when demand falls, the oligopolists who set the price to their output have multiples possible responses and no simple answer can be given without additional information. However, it can be said that the oligopolists will refrain themselves in doing too many changes in prices to maintain producers' discipline, to avoid confrontation and to reduce the possibilities of a price war so that they will try to regulate stocks and/or output and attempt to maintain a conservative price policy. There exists the possibility that the producers' efforts result unsuccessful but at least they will tend to avoid the alternative course of action.

In the case that the parameter of action of the oligopolists is output, their possible reactions to a demand reduction are many. However, if it has been accepted that producers coordination is difficult, the possibilities that they can sustain the price without explicit collusion are relatively small. In the absence of an understanding it is unlikely that a producer gives the first step to support the price without the assurance that the others will take the same decision, simply because by reducing output he may be giving away business which may easily be captured by his rivals and he has not any effective mechanism to recover it, as for instance to undercut the market price: his only possible response would be to increase output, driving down the price, but this alternative involves the risk of a possible time lag which may reduce the effectiveness of his action.

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From this discussion it can be concluded that when the parameter of action of the oligopolists is output the possibilities of coordination are more difficult. The system of operation is less flexible in the sense that the producers can not use courses of action which seem to be more effective to maintain producers' discipline, so that the system tends to be more competitive than when the parameter of action is price.

#### 6.2.4 The Process of nationalisations

In 1964-74 in Chile, Peru, Zaire and Zambia a process took place whereby the governments of these countries increased their participation in the copper industry and in the commercialisation of this raw material in the international market (1). The process affected 34.4% of world production, 42.6% of the market economies output, and 73.0% of the net copper exports of the capitalist countries.

Although the Chileanisation of the copper industry influenced the decision of the Zambians and, probably, the 1966 negotiations between Zaire and Union Miniere, the processes were completely independent in each country and adopted different forms and characteristics. This is largely explained by the economic, social, political, cultural, and historical differences of the countries involved.

The process took place in developing nations whose economies depend to a considerable extent, but in different degrees, on their copper exports. Zambia and Zaire had recently become independent and their national governments were organising the state and the economy; the Chilean and Peruvian governments were undertaking economic and social transformation. But, except in Chile only in 1971-73, the process did not intend to socialise the economies but rather to establish a system by which the State could become a more active agent in the copper industry as a mechanism to increase the foreign exchange earnings of their countries in order to finance programs of development and to reduce balance of payment pressures.

The objectives defined by the governments were basically the same: to integrate the copper industry into the national economy, to increase production, to augment forward integration and the participation of

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nationals in the management of the companies. The chosen mechanism, to increase the participation of the governments in the industry, except in Peru, through partial or total nationalisation was also very similar.

The measures adopted in the developing countries considerably affected the position of the five companies which had controlled the copper industry in the market economies, Anaconda, Anglo American, American Climax, Kennecott and Union Miniere - to Kennecott its Chilean subsidiary represented 33% of its total mining output; 70% in the case of Anaconda and almost the total copper mine production of the other three companies.

Conversely, to the governments, the changes in the relation of production accounted for almost their total copper production and, except in Peru, the most significant source of foreign exchange of the country.

Despite the fact that the major decisions by the governments were made on one date, they are being considered here as a process. This was firstly because negotiations preceded or followed each of the decisions, involving the host governments, the companies and in some cases the government of origin of the corporation; second, the contracts between the host government and the companies were modified at least twice. If the negotiations and retaliatory measures by the companies are considered, it can be concluded that in each of the years of the period 1964-74 there were changes in the relations between host governments and the companies in at least one country. The probability that producers colluded in any other way than to base their price policy on the LME was relatively small. But there were other factors which contributed to the persistence of such a situation as will be seen later.

A brief description of the process of changes in the producer relations in each of these countries may permit a better assessment of the situation.

#### 6.2.4.1 The process of nationalisations by countries

##### 6.2.4.1.1 Chile

In December 1964, the then recently elected President of Chile defined his copper policy of Chileanisation of the large scale copper industry. Five objectives were established: to double copper production in the next six years; integration of the industry into the national economy; state participation in ownership of the copper mining companies; refining in Chile of the largest possible proportion of mine production; and active participation of the State in the international marketing of copper.

At the same time President Frei announced that his government had reached agreements with the U.S. copper companies to implement his programme of Chileanisation.

The President had to send a Bill to the Congress to meet the conditions demanded by the companies, as well as to modify the institutional conditions to implement his programme. The Bill was finally approved in 1967.

The agreements included plans for investment by all the large companies and the creation of three companies in which the State took ownership participation.

- i) A joint stock company was formed with the Subsidiary of Kennecott which exploited the minerals of El Teniente. The State held 51% of the shares and Kennecott the remaining 49%.
- ii) The agreement with Anaconda included a joint venture with the government to develop the deposit of Exotica; the government subscribed for 25% of the shares and Anaconda for 75%. But there was no agreement to create joint stock companies either in Chuquicamata or in El Salvador, which continued being wholly owned by Anaconda.
- iii) There was another agreement signed with Cerro Corporation, a company without other interests in the country. A company was formed to develop a small deposit where the government subscribed for 30% of the shares and Cerro for 70%.

According to the agreements the companies retained managerial and marketing responsibility for the copper. The Chilenisation plan also implied a drastic cut of the tax rates to the companies.

From 1967 to 1969 the opposition to the copper agreement grew in such a way that two of the three candidates for the Presidency of the Republic presented as a basic point of their programmes the nationalisation of the Chilean copper industry. Those two programmes had the support of 70 per cent of the voters.

In 1969, the government demanded further negotiations with Anaconda. After a short period of negotiations agreement was reached by which the Chileans would buy 51% of the shares by January of 1970, with an option to buy the rest of the stock between 1973 and 1982. Anaconda kept control of the management of the company and the marketing of the copper in the international market.

In September 1970, Salvador Allende was elected President of Chile; the same month and before Allende took office, the President of the U.S. and his Secretary of State decided that their government had to take steps to overthrow the Chilean President (1). In 1977, in the final part of the Nixon's interview by D. Frost the former defending his policy, said "There was not any question about his turning all the screw he possibly could in the direction of making Chile a Marxist State ...." (2) and he continued giving the reasons of the U.S. intervention.

In November 1970, President Allende sent a Bill to the Congress to nationalise the large scale copper industry. The Bill was unanimously approved in 1971 and the same year the Chileans took over the management of the companies and the marketing of the copper in the international market.

In 1972, Kennecott started court actions against the Chilean Companies, both in the U.S. and Europe. The action of Kennecott was intended to obtain an embargo on Chilean copper shipments and also sought to stop customer payments to Chile.

The same year the U.S. drastically reduced copper imports from Chile (3). There were also increasing difficulties in obtaining spare parts in the U.S., the country of origin of the equipment of the Chilean's copper mines. All these measures were part of a wider plan whose objective was "to strangle" economically the Chilean government, to create the political condition for a coup. Such a plan also included the financing of a strike in the second largest Chilean copper mine, El Teniente, in 1973 (4).

The copper mines were nationalised according to both Chilean and International Law (5).

(1) See J. Petras and M. Mosley "How Allende Fell, A Study in U.S. Relations". Spokesman Books, 1974. See also U.S. Congress, Senate, Committee on Foreign Relations, Subcommittee on Multinational Corporations, The International Telephone and Telegraph Company and Chile, 1970-1971, Committee Print, June 21, 1973, 93rd Congress. Washington: U.S. Government Printing Office, 1973.

(2) Time "No one knows how it feels". Time, June 6, 1977, page 25.

(3) U.S. Department of Interior, Bureau of Mines: Copper 1977, page 10.

(4) Keessing's Contemporary Archives: Allegations of CIA Involvement in Chile, May 12-18, 1975, page 27124.

(5) E. Vargas "La Nacionalizacion del Cobre y el Derecho Internacional". in R. French-Davis and E. Tironi "El Cobre en el Desarrollo Nacional". Ed. Nueva Universidad, 1974.

E. Novoa "La Batalla por El Cobre" Ed. Quimantu, 1972.  
The point of view of the companies in Kennecott Copper Corporation, "Expropriation of El Teniente, the Largest Underground Copper Mine", New York, 1971.

The Coup d'Etat occurred in September 1973, and a Military Junta took over the government. The managers of at least two companies as well as other technicians and workers were shot; at least one hundred professionals were dismissed while others had to go to exile.

In less than three years the Chilean copper industry had two changes in the top administration; the first, when the copper industry was nationalised the second when the Junta took over the government.

The Junta did not denationalise the copper mines, and they continued to be owned by the State. The military government began negotiations with the U.S. companies; in March 1974, the Junta agreed to pay 41.8 million dollars to Cerro Corporation; on July 24 1974 Anaconda announced that an agreement had been reached whereby Anaconda was to receive a cash payment of 65 million dollars and a further 188 millions in promissory notes which were payable in twice yearly instalments over a 10 years period. On October 24, it was announced that Kennecott was to receive 54 million dollars, payable in 19 six-monthly instalments, in addition 14 millions which Kennecott claimed as dividends and interests outstanding for the end of 1970.

The central basis of the military government is to attract foreign capital to develop new deposits and to create joint ventures in which the government would have 49% of the shares. It was recently signed a contract with Noranda to develop El Abra; a specialised publication on copper reported that the government had frozen the taxes for 30 years, representing "an important and unusual concession by Chile to the companies' demand for investment security", and it added "there is a notable omission in the question of environmental protection and pollution control, which are not mentioned anywhere in the agreement" (1).

The policy of attracting foreign capital to the copper industry by tax reductions and other concessions has become an additional source of competition whose implications are considered in the next Chapter.

The second important development of the new copper policy has been that CODELCO decided to build a continuous cast rod plant in Germany. CODELCO formed a joint venture with Norddeutsche Affinerie and Huttenwerk Kaiser on a 40, 40, 20 per cent basis (2). The plant began to operate

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(1) Copper Studies, October 1977.

(2) Chile, Mensaje Presidencial, 11 September 1975 - 11 September 1976, page 316.

in 1977 and has a capacity of 120,000 tons; the Chilean mines will supply 60% of the cathodes required as input.

It is difficult to say to what extent this decision was integrated to a plan. But there were also discussions to invest in Britain and Italy, but in both countries there was over capacity (1) already (2).

The unusual fact that the government of an underdeveloped country decided to invest in such a process of production, in an industrialised country, implies that it has ruled out the overall objective of most raw material producing countries, i.e. downstream integration within the countries.

But the decision also created a new source of non-price competition because other copper producing countries have been trying to follow the Chilean measure. The discussion of this subject must be postponed.

#### 6,2,4.1.2 Peru

In 1968, the government of President Valasco Alvarado defined the goals for the Mining Industry: to increase the participation of the Peruvian State in the mining industry; State control over the marketing and refining of mine production; to increase vertical integration in the sector within Peru; to stimulate worker participation in mining companies, equity and management (3).

The next year, the government took a series of steps in order to implement such objectives. Here reference is made to four of them:

(1) In 1969-70, the government introduced legal requirements for companies holding undeveloped mineral concessions including the obligation to meet minimum development of the deposits. The legislation was based on the Spanish precedent (4) that the holders of unworked minerals had to relinquish their concession to the State. As a result of this legislation, copper concessions held by Anaconda, Southern Peru and Cerro de Pasco reverted to the State in a relatively short period.

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- (1) W. Page: An Exploration of Attitude, Expectations and the Plans of some South American Mining Executives. University of Sussex, Mimeo, 1977.
- (2) In 1979 the author was informed that CODELCO had reached an agreement with a French company to invest in another cast rod plant in France.
- (3) Janet C. Ballantyre: "The Political Economy of Peru Gran Minería 1968 to 1973". Ph.D. Thesis Cornell University Latin American Studies Program, 1974.
- (4) J.C. Bossio Rotondo: Development de l'Appareil d'Etat dans les Pay arrieres et Nationalisations: le Cas de l'Industrie de Cuivre.

It seems that the strategy of the government was to recover the deposits in order to develop the most economic ones as rapidly as possible, either in association with foreign companies or by Minero Peru, the state owned Mining Company,

ii) In 1970 the government issued Decree 18225, Norms of the Mining Industry, which replaced the 1950 Mining Code. Under the new legislation the State retained the right to work all mines, though contracts or concessions could be granted whether to Peruvian or foreign companies; incentives were offered to investors who entered into joint ventures with the State which was to hold an interest of at least 25%.

The same legislation gave to Minero Peru the control of the sales and the refining of the mineral products.

iii) In 1969 the government signed a contract with Southern Peru Copper Corporation for the exploitation of the Cuajone copper deposit which was to increase the Peruvian copper production by nearly 50%. The agreement guaranteed the marketing of copper, above the quantity required to satisfy the local market, by the company, during the period in which the corporation was recovering its initial investment. But the company was to sell the copper at the Peruvian producers' price (1).

iv) On the last day of December 1973, the government nationalised all property of the Cerro de Pasco Corporation, a subsidiary of Cerro Corporation, transferring this properties to the State owned Centromin Peru.

The government adopted the decision after two years of negotiations with Cerro Corporation. The breakdown of the discussions was due to disagreement on compensation.

Early in 1974, the U.S. and Peruvian governments signed an agreement which Peru paid the U.S. government 76 million dollars as compensation for a total of 12 companies taken over by Peru. Of that total 67 million went to Cerro Corporation.

The new structure of the Peruvian copper industry is based on a privately owned company, Southern Peru, which controls most of the copper production of the country, i.e. 80 per cent before the expansion, and about 90 per cent after Cuajone started production.

But the government created two important bases for the development of the copper industry of the country: the marketing infrastructure to sell the copper and other mineral products in the international market;

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(1) Bossio Redondon: Ob.cit., page 15.



second, it increased the alternatives for the development of its natural resources in general and copper in particular: it is able to negotiate with companies other than those which controlled the mineral deposits, or to use its own capacity to exploit its deposits.

#### 6.2.4.1.3 Zaire

In Zaire the most important measures related to the copper industry began to be adopted after the long period of internal political conflicts in 1960-66.

Negotiations between the government of General Mobutu and the Union Miniere officially started in October 1966. It seems that the basis of an agreement was laid down in the following month (1), but negotiations were interrupted early in December.

Reports at that time suggest that the most important sources of conflict were the disagreement on the amount of the compensation and on the fact that the Congolese wanted to reduce the share of Union Miniere in the structure of the capital by making other interests participate in the ownership of the company.

On December 22, the Board of Directors of the Union Miniere published a declaration in which they claimed that arbitrary measures had been adopted against the company after the independence of the country. At the same time it was announced that they had decided not to meet the demand of the Congolese government to transfer the headquarters of the Company to Kinshasa.

The following day the Congolese authorities announced the formation of a new company in which 55% of the shares would be held by the government, 17% by British interests and the remaining 30% by private interests, both Congolese and foreign.

The British company involved decided that it could not be a party to an illegal act of confiscation. On 31st December the Congolese authorities

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- 1) According to a report of the Economist, the basis considered the following points:
- i) all the assets in the Congo of Union Miniere would be transferred to a new company, Union Miniere du Congo.
  - ii) In the new company the Congolese Government would hold 50 per cent of the shares and Union Miniere the remaining 50 per cent.
  - iii) The Government would also hold 17% of the shares of Union Miniere in Belgium and a 25% voting right in Union Miniere.

decided to form a new company, Societe Generale Congolaise des Minerais with 60% of the shares owned by the government, to take over the Union Miniere assets in the Congo on January 1st, 1967. The remaining 40% were reserved for foreign private companies.

The Belgian government, which had declared it would not take sides in the dispute but press for the rights of Union Miniere, formally expressed its disapproval of the decision adopted by the Congolese government (January, 1st 1967), and a few days later the Prime Minister declared that no state would "accept without compensation the nationalisation of enterprises abroad in which its industrialists, its technicians and its investment are deeply engaged" (1).

On January 5, the Union Miniere issued an instruction to the Belgian employees in the Congo to leave their posts and return to Europe by January 31, 1967, or to consider themselves dismissed. The decision affected about 1,600 technicians who occupied the key positions in the installations in the Congo. The decision had the support of the Belgian government.

In the conflict the weakest position was held by the Congolese side. About 50% of its copper production had to be refined in Belgium, the sales of minerals were suspended on December 23, which meant that almost all the foreign exchange revenue of the country was cut off; as the sales were handled from Brussels, the contracts were unknown in Kinshasa, even information records as elementary as the subsoil maps were in Belgium.

But the Belgian government was interested in overcoming the conflict as soon as possible, otherwise other interests were to penetrate in an area they had controlled for about 60 years; the government of Mobutu was trying to engage Belgian-French capital in the Congo; except for Union Miniere, the supply-demand for copper were almost in balance in the international market and European clients were pressing for a solution of the situation.

Meanwhile Mobutu's government was actively trying to encourage rivals of Union Miniere to take over the 40% of the shares of Gecommin, available in the private sector. Four groups were involved in these negotiations, the Belgian Banque Lambert (associated with the Rothchild group), Societe Penarrova (one of the largest copper consumers of France), Roan Selection Trust and the Anglo American Corporation. Penarrova was the first company

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(1) Le Mond, Janvier 8th, 1967.

which withdrew from this group. Anglo American and Roan Selection Trust declared that they had only taken part in discussions which intended to solve technical problems to maintain the Congo's copper production, and that no agreement had been made on forming a copper corporation. Representatives of the Belgian bank declared, according to press reports at that time, that although no consortium had been formed, the Banque Lambert would accept the invitation to study the possibility of its participation in such a venture on two conditions: first, recognition by the Congolese government of the principle of equitable compensation to be paid to Union Miniere for the nationalisation of its assets; second, that in the consortium it would have to include Union Miniere for marketing the copper.

On January 15, the government of Mobutu published two decrees, by the first permitting the State to take over all the assets of Union Miniere in that country, including 13 subsidiaries and the second removed the right of the Union Miniere to operate in the Congo, and revoked the mining concession granted to Union Miniere by the Belgian colonial administration in 1906.

It is noted that the complete nationalisation of the Congolese copper industry was brought about basically by the dynamics of the circumstances rather than by principles derived from a policy of the government.

The tense relation between the parties continued until on February 17, a provisional agreement was reached which was valid for three years and subject to termination at two years' notice. The contract defined that the Societe Generale des Minerais should:

- a) continue to be responsible for the marketing of the copper.
- b) have the sole responsibility for the technical assistance in ore extraction and refining in Gecamines.
- c) be solely responsible for the employment of European experts.
- d) buy the copper at the international market price.
- e) provide for the proper functioning at Gecom's installations the employment of its personnel, and the mining, industrial and commercial administration of its enterprise.
- f) and that Gecom would pay a commission of 1½% of all its sales to the Societe Generale de Minerais.

The weakness of the Congolese government is revealed by the terms of the contract and no further comment is necessary. The conflict with the Union Miniere cost about 67 million dollars (3 billion Belgian francs), taking only into account the suspension of the sales of copper from December 23, 1966 to February 15, 1967.

The conflict was over, despite the fact that negotiations on the compensation lasted until September 1969, when a new agreement was signed whereby Gecamines would pay a compensation equivalent to 6% of the sales to the Societe Generale des Minerais for the next 15 years; thereafter, the sum payable to Societe Generale des Minerais was to be reduced to 1% of sales as a fee for technical assistance. Under the agreement Societe Generale des Minerais continued controlling the sales of copper, cobalt and other products of Gecommin.

While the compensation to Union Miniere was under negotiation the Congolese government made contact with companies from other countries to develop different copper deposits to undertake mineral exploration activities in its territories. As a result, a group of Japanese corporations brought into production a copper deposit with a capacity of about 40,000 tons per year in the early 1970.

Another consortium of companies from different countries started the development of the Tanke Fungurume deposit, but investment was suspended in 1977 because of the low copper prices.

In both companies the government has minority interests but the contracts include a clause by which it can increase its ownership to 50%.

In 1974 a new agreement was signed between the Zairean Copper company and Societe Generale des Minerais which laid down that Belgium Company was to be paid 95 million U.S. dollars in March 1975 to compensate it for the loss of its holdings in Zaire. Societe Generale des Minieres will continue to provide technical assistance to the Zairean copper industry, it will also participate in the construction of a new refinery, and Zaire could set up a new metal marketing company to sell the mineral produced in the country.

When President Mobutu announced the new agreement he also declared that any future venture in the mining industry would require a 50% government participation and that the companies would have to appoint Zaireans as Chairman and managing director. The agreement signed in 1969 would not be affected by this new disposition.

#### 6.2.4.1.4 Zambia

In Zambia, the first step to control the copper industry was adopted a few hours before the first independent government took office; the Chartered Consolidated Ltd. was nationalised.

Chartered Consolidated had been the company responsible for the administration of the territory of Northern Rhodesia until 1924, when the British government took over the administration of the territory. The company had also the monopoly of the mineral rights in Northern Rhodesia. Chartered granted mineral rights to the two groups of companies which began the exploitation of copper in the colony, Anglo American Company and Roan Selection Trust. Both of them had to pay a royalty to Chartered. The payment was calculated as a percentage of the gross value of the copper produced, taking as a basis the LME quotation.

Before independence, the Northern Rhodesia made clear to the British government that the Chartered Consolidated had to be nationalised. A few hours before independence, and after a long period of negotiations, the governments of the U.K. and Zambia offered 2 million pounds each to Chartered Consolidated for its mineral rights whose representative reluctantly accepted.

As a result of this nationalisation, the mineral rights of Northern Rhodesia reverted to the Zambian government, and the copper companies had to pay the royalty to the government. From 1964 to 1968 the Zambian government did not develop an integrated copper policy. This can be explained by the effort required to organise the state apparatus to deal with the new conditions, while they faced a shortage of technicians and people with experience. Moreover, the unilateral declaration of independence of Northern Rhodesia and the economic sanctions adopted against this country intensified the adverse conditions for the Zambian government. In 1964, more than 40% of its imports came from Southern Rhodesia, and all imports and exports had to use the transport network of that country.

The copper companies were facing institutional, political, economic and social changes. They were also confronted by important cost pressures. Therefore it was important for them to obtain a definition of the government policy. It seems that the companies decided a strategy to test the position of the government by asking for a modification of the tax system in particular the royalty payments which were unrelated to the profitability of the minerals.

The government replied that the companies had been paying these royalties for the past 30 years without questioning publicly. Threats and counter threats followed until August 1969 when President Kaunda announced its Zambianisation policy according to which the government was to buy 51% of the assets of the two copper companies operating in the country, Roan Selection Trust and Anglo American Company. The new measure had to be

put into effect before January 1st, 1970. The announcement gave only four months to both parties for starting negotiations and reaching an agreement.

On December 24 1969, agreements were signed by the Zambian government and the two private companies. The 51% of the shares acquired by the government were to be held by Mindeco, a new State-owned company, a subsidiary of the Zambian Industrial and Mining Corporation (ZIMCO).

The copper mining companies owned by the Anglo American Corporation formed a new company, the Nchanga Consolidated Company, and those mining operations owned by Roan Selection Trust passed to the Roan Consolidated.

It was decided that in return for the 51% of the shares, ZIMCO issued loan stocks and bonds, guaranteed by the government. The payment had to be made in a period of 8 and 12 years in the case of Roan Selection Trust and Anglo American Corporation, respectively.

The management of the companies and copper marketing was reserved for the minority shareholders for at least 10 years. For the services rendered by Roan Selection Trust and the Anglo American, they were to be paid 0.75% of the sales and 2% of the profits before tax (1).

The agreement provided a set of guarantees for the companies, probably the most important of which were the freezing tax of both private companies during the period of payment of the shares and the exemption from exchange control of the dividends of the minority shareholders.

It is not possible to analyze the complex agreement in further detail but it should be noted that when a State buys a 51% of the shares of a company, the contracts require the formulation of a complex set of rules whose legal definition by itself is a challenge. From an operational point of view, they imply that the possibility of action is restricted affecting the flexibility of the company. This situation is even more important in an industry affected by continuous changes in both prices and demand, and when the economy of the country depends to a considerable extent on that industry.

In 1973, the Zambian government announced a change of policy affecting the mining industry. As a result of the negotiations with the two private companies it was decided that the government was to create a State-owned Corporation responsible for the marketing of home-produced copper as well as other minerals in the international market. Also the arrangements under

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(1) Bossio Rotondo, Ob.cit, table 5.

which Roan Selection Trust and Anglo American provided management services to Roan Consolidated Mines Ltd. and Nchanga Consolidated Copper Mines Ltd., respectively were terminated. Another important change was the redemption of all outstanding bonds issued by MINDECO.

6.2.4.2 Nationalisations: changes in structure and behaviour, a general appraisal

A process of changes in the relations between the host governments and the private foreign companies was expected in all the four countries.

The Chilean copper industry had experienced a market share lost respect the forties: the companies had not made any important investment apart of the 200 million dollars by Anaconda to replace the exhausted mine of Potrerillos: there was concern among the Chileans for this situation; but early in the 1960s the companies were interested in reaching a long run agreement with the Chilean government.

In Peru the government was interested in the expansion of the copper industry because this country had one of the largest volumes of undeveloped reserves in the world.

Zaire and Zambia had become independent countries in the 1960s; the regulations of the operation of the copper companies had been defined by colonial authorities, without participation of the nationals of these areas; a modification of the policy by the governments of the new nations was expected.

It is important to note that four of the seven companies established in these areas accepted equity participation of the governments. In Chile, Kennecott put the proposition to the Chilean government. In Zaire, Union Miniere had accepted ownership participation of the government before the break-down of negotiations in 1966. In Zambia, a report of the UN (1) in 1964 recommended such a measure; the same year the Chairman of Roan Selection Trust declared with reference to this proposal "I would welcome this very much indeed. I know that this view is shared by the other group" (2); this was five years before the Zambian government defined its copper policy.

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(1) UN/ECA/FAO: Economic Survey Mission on the Economic Development of Zambia.

(2) R.L. Prain: Selected Papers. 1964-67, Vol.4, page 11. Roan Selection Trust 1968.

If these countries are considered as a unit, the process of changes in the relation between the companies and host countries lasted eleven years, starting by the nationalisation of Chartered Consolidated in Zambia and ending when the Chilean Military Junta agreed the payment of compensation to the U.S. companies for the nationalisation of their subsidiaries.

During this period there was not a single year in which negotiations or renegotiations between the host government and the copper companies did not take place and/or relevant decisions were not made in any of these countries. The process was not simultaneous, rather it was scattered in time. When agreement had been reached in one area negotiations or renegotiations started in another, either at the initiative of the companies or of the governments.

It seems that agreements generated an unstable equilibrium; they were renegotiated or revised at least twice in each country.

These situations are illustrated in table 6.4 where the major decisions adopted by these four countries are summarised.

1966-72 can be considered a period of transition in which the position of the five companies operating in Chile, Zaire and Zambia gradually deteriorated, though to different extents, while new companies, totally or partially owned by the governments emerged. In Peru, the situation was different, the only copper company nationalised was Cerro de Pasco, a relatively small producer but the government took over greater responsibilities in the industry.

In Zaire and Zambia the copper industries were partially and fully nationalised but the former owners signed managerial and marketing contracts with the governments. Both countries renegotiated these contracts in 1973. In Chile, the government signed similar contracts with Kennecott for the operation of El Teniente, in 1964 and with Anaconda in 1969; the contracts lasted until the total nationalisation of the subsidiaries of both companies in 1971.

Uncertainty was another factor which affected both companies and governments though to a different extent and at intensities varying over time.

In Chile the 1964 negotiations were relatively rapid. However public and political opinion considered the agreements too favourable to the companies. As a result Anaconda accepted negotiations with the government: the company offered what had been rejected a few years before, to sell 51% of its two subsidiaries in Chile. Two years later the companies were totally nationalised.



Table 6.4

Summary of the major decisions adopted by Chile, Peru, Zaire and  
Zambia in the copper industries 1964-74

<u>Year</u>	<u>Countries</u>	
1964	Chile	Announcement of Chilenisation of copper industry.
	Zambia	Nationalisation of the Chartered Consolidated Company.
1966	Zaire	Nationalisation of the Union Miniere de Haut Kanata, but compensation negotiations lasted till 1969.
1967	Chile	Congress approved Bill on the copper industry to implement Chilenisation of the copper industry.
1969	Chile	Pacted nationalisation of Anaconda: this company agreed to sell 51% of the shares of its two subsidiaries to the Chilean government.
	Peru	Agreement with Southern Peru to develop the Cuajone deposit and first modification of the legislation on mineral rights.
	Zambia	Zambianisation of the copper industry is announced.
	Zaire	Agreement between Union Miniere and Gecamines on compensation of the ex Union Miniere de Haut Katanga.
1970	Chile	Government sent to the Congress Bill on the Nationalisation of the large scale copper industry.
	Peru	New mineral code is promulgated. Further modification of the legislation on mineral rights: undeveloped mineral deposits began to revert to the State.
	Zambia	Government bought 51% of the shares of the Zambian mines controlled by Roan Selection Trust and Anglo American Corporation.
1971	Chile	Approval of the Bill of nationalisation of the large scale Mining Industry. The government took over the mines.
1972/ 1973	Chile	Retaliation by the copper Companies against Chilean government. These measures coincide with efforts by U.S. Government which intended to overthrow Chilean government.
1973	Peru	Failure of the negotiations with Cerro Corporation to nationalise Cerro de Pasco.
	Zambia	President Kaunda announces intention to modify agreements with Anglo American Corporation and Roan Selection Trust.
1974	Chile	Military Junta agreed to pay compensation to Anaconda, Cerro Corporation and Kennecott.
	Peru	Government nationalise Cerro de Pasco. Agreement for compensation is reached with the U.S. government

Zaire	Modification of the agreement with Union Miniere.
Zambia	Modification of the agreement with Anglo American Corporation and Roan Selection Trust. Cancellation of the management and sales agreement. Creation of MEMACO responsible of marketing copper in the international market.

In Zaire, Union Miniere de Haut Katanga was nationalised in 1967 but negotiations lasted until 1969.

In Zambia, the institutional changes were expected since the independence but were announced five years after it, in 1969. In that period it was reported that one of the companies intended to sell its interests in Zambia to a German company: the reason given was the uncertainty in that country. Whether this was a mere threat or a real decision will never be known.

Uncertainty also affected the governments which had to adopt significant decisions about the future of one of the most important activities of their countries.

In this group of countries, the governments took more responsibility in the copper industry facing deficits of national skilled labour and people with experience in the management of an activity of such magnitude. These deficits affected to a different extent the countries under consideration. The problem was more acute in the Central African countries than in the South American.

It is important to note that in all these countries, transformation in other economic sectors were being carried out and in the Central African countries the Central government was being organised: therefore other activities were also demanding and competing for skilled people with the copper industry.

At independence Zambia, there were 109 African graduates in the country and 1,200 Africans holding secondary school certificates (1) a substantial improvement of this situation will take several years. In the mining industry, the technical and managerial functions were carried out by expatriate people. In Zaire the situation was similar.

In Chile, the situation was different because most of the technical functions were fulfilled by nationals though the managers and key positions were occupied mainly by US citizens. At the time of the nationalisations, 1971,

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(1) William Tordoff. Zambia: The Politics of Disengagement. African Affairs The Journal of the Royal African Society. Vol. 76, No. 302, January 1977, pages 60-69.

most of the 150 (1) foreigners left the country: some Chilean technicians signed contracts with Anaconda and Kennecott, it was around 100. Most of these functions were to be carried out by people whose background was not directly connected with the copper industry.

In Peru, there was also a deficit but the necessity did not become as pressing as in the other countries which took over direct responsibility in copper companies.

There is no quantification of the total deficit of skilled workers in the copper industry in these countries. B. Rotondo gives an estimation of the shortage of engineers in 1970-72, though the method of estimation is not defined and the word engineer which has different meanings in different countries is not defined.

Table 6.5  
Shortage of engineers in Copper Industry  
1970-72

Countries	Medium Run Shortage
Chile	352
Peru	672
Zaire	241 (a)
Zambia	708 (a)

TOTAL 1,978

(1) Total employment of Engineers less number of Nationals

Source: J.C. Bossio Rotondo: Nationalisation and Technological Dependency. The Case of the CIPEC Countries. Mimeo. Extracted from table 3 of the statistical appendix.

It is obvious that a shortage of trained people would have existed in the copper industry of these countries if nationalisation would not have taken place and that the management would have been provided by the multinational companies. However, the nationals of these countries would not have had the possibility of occupying key positions without nationalisation. The companies did not train nationals for more than 30 years and there is no reason why they were to change this policy in the future.

In the case of the producing countries, the Arabs prepared experts in oil to negotiate with the multinationals, so when some countries nationalised their industries, these trained people occupied the managerial

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(1) E. Bablanoff: Expropriation of U.S. Investments in Cuba, Mexico and Chile, page 101. Raeger Publishers, New York, 1975.

positions. But this was not the case in any of these copper producing countries, two of them had been under colonial rule and Chile and Peru had followed a relatively liberal policy in their copper industries.

It should be noted that copper production was not affected by the nationalisations. This general statement requires several qualifications.

In Chile, the 1964 agreements included a programme of investment of about 600 million dollars; it was intended to duplicate copper production of the large scale size mining industry. The investment was almost completed at the time of the total nationalisation in 1971. Afterwards, the target of production defined by CODELCO were not reached due to technical problems but production increased.

The Zairean production was only disrupted for three months after the nationalisation, but historical levels of output were maintained. A mine was brought on stream but by a Japanese company, Sodimiza.

In Zambia, production fell but as a result of an accident which was not related to the process of Zambianisation.

In the four developing countries, there were also changes in the policies of mineral concessions which also affected the position of the former leading companies.

Anglo American had completed monopoly of the Zambian copper reserves through Chartered Consolidated which was nationalised in 1964; mineral reserves diverted to the government who in turn signed contracts of exploration with other companies.

Union Miniere had also the monopoly of the Zairean copper reserves, which diverted to the State who in turn granted concessions to other companies. As a result of these reallocations the Japanese entered into copper mining in Zaire.

In Peru, as a result of the change in policy of mineral concessions, an important part of the undeveloped copper deposits diverted to the State, affecting ASARCO, Anaconda and other U.S. companies. Part of them have been granted to other companies, among others Japanese interests but the most important deposits are controlled by Minerio Peru, a State owned subsidiary.

In Chile, the mining concession policy also changed as a result of the nationalisation; Anaconda, Kennecott and at a lesser extent Cerro de Pasco lost their position.

In this period it could be expected that the changes in policies in these areas were going to have important influence on the strategies, policies and decisions both of other companies operating in the copper industry and of the copper importing countries. Despite this situation neither the governments nor the companies defined a common strategy to minimise the adverse effects.

There is no simple answer to this lack of definition. In general it can be said that neither the governments nor the companies were in conditions to negotiate an understanding with other participants in the market if their parameters of action were to be affected by the negotiations of the institutional status of the companies. This is more important when the number of changes in policies which took place in each country are considered.

It is important to consider other relevant factors which influenced the non-formulation of a common policy by the governments.

Nationalisation did not change the rival relation between these copper companies and it is possible to say that in the new conditions interdependence was less flexible than before due to the structural weakness of the nationalised companies (see final pages Chapter 5).

It is logical to think that the new copper companies were initially more concerned with the operational problems of the industry than with the marketing strategy decisions. As a matter of fact, only Chile (but in 1971) took over these functions; the governments of the Central African countries did not control these functions until 1974.

It is also important to note that these countries had not any experience in working together.

In this period, the governments of this group of countries organised the Intergovernmental Council of Copper Exporting Countries, CIPEC, but the new organisation did not play any role in the definition of a common policy in this period. It has been stated that CIPEC discussed a mechanism to stabilize the prices of copper in 1969 and in 1971 but none of them were implemented; however at that time the situation not only demanded a stabilization scheme but a more integrated copper policy.

The indefiniteness of a policy by these countries was not the only factor which determined other changes in the structure of the copper industry, but this lack of definition made easier the implementation of the policies of other companies and those of the consumers. Before referring to these other changes, the general conditions of the copper market will be described.

#### 6.2.5 The market conditions in 1966-72

The second half of the 60s was characterised by high levels of demand for copper caused by high growth of the industrial activity in the market economies and additional requirements of copper to supply the increasing demand for military equipment for the war of Vietnam: in the U.S. despite the high levels of strategic stock, the government introduced a policy of set aside production, to supply with priority military requirements.

In 1966, demand was greater than supply. The U.S. government disposed of 360,000 tons of its strategic stock piles, reducing the pressures of imports from the international market, reversing the increasing trend of the last two years. It was expected that new capacity of production was to reach the market in 1967, in such a way that supply and demand were to reach equilibrium for the first time in three years.

However, the production was interrupted in Zaire during the first months of 1967 as a result of the break-down of the negotiations between Union Miniere and the Zairean government. In August the strike of the U.S. miners started and was to last 8½ months. High levels of stocks of the consumers and a new release of strategic stocks by the U.S. government 100,000 tons, reduced the impact on prices. Only in 1968 the U.S. mines restarted activities.

In 1969, demand was still high: but two other factors interacted: additional demand to re-establish the stock consumed during the U.S. strike, and the socialist countries bought a relatively important amount of copper in the free market. Prices began to increase again to reach the highest level in December. Only in 1970, the prices began to fall, a situation which reflected the recession of 1970-71, which in turn caused the stagnation of the consumption of copper. In 1971-72 production from new capacity began to reach the market; Canada, Chile, Philippines, Zaire and from two new areas Indonesia and Papua New Guinea. Prices continued their trend down.

In 1966-70 the prices of copper in the LME were roughly 20% higher than those required to bring into stream a new mine, including in cost a 15% return to capital. This was an additional factor which contributed to the generation of the unbalance between capacity of production and demand which was to characterise the 1970s.

Table 6.6  
Quarterly Average of the London Metal Exchange wire bars Quotations  
1966-72  
(in cents of dollar)

Years	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Average
1966	82	80	59	57	69
1967	54	46	47	58	51
1968	73	53	49	51	56
1969	58	64	70	74	67
1970	76	72	59	49	64
1971	48	52	49	47	49
1972	51	50	47	46	48

The decisions of investment are based on future or projected prices, and not in current prices, this is particularly important in an industry such as copper due to the lead time required to bring on stream a new mine. However, the current prices seems to have an important influence on the projected prices used to evaluate a project of investment. As a matter of fact important decisions of investment were made in 1967-69 by companies other than the leading copper suppliers of the international market as will be seen.

The prices of copper fluctuated at a relatively high level relative to the prices of its closest substitute, aluminium, in the second half of the 1960s. Aluminium made an important inroad in the electrical market. This can be illustrated on the basis of the information referred to the French market for insulated wire.

Table 6.7  
France, insulated wire, market share by weight of aluminium and copper  
in 1961-1973 a)  
(percentage)

Years	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Aluminium	2.9	3.5	4.0	4.0	3.6	6.9	8.0	8.2	9.5	10.4	12.6	12.8	13.4
Copper	97.1	96.5	96.0	96.0	96.4	93.1	92.0	91.8	90.5	89.6	87.4	87.2	86.6

a) For 1971-73 the information is referred to the total market of wires.

Sources: Based on CIPEC: Report to the Governmental Council, 1971.  
Roskill Information Services: Copper, Survey of World Production Consumption and Prices, 1975.

The process of substitution affected the copper industry in all the market economies. There is no information for all the important copper consuming countries to cover the whole period, but it is possible to estimate that the inroads of aluminium in the cable and wire industry were not different to those in France in the first years of the second half of the 1960s and afterwards followed a similar trend as can be seen in table 6.8.

Table 6.8

West Germany and U.S. copper and aluminium market shares in the cable and wire industry in 1969-73  
(percentage)

Years	FR Germany			U.S.		
	Al	Cu	Total	Al	Cu	Total
1969	6.5	93.5	100	n/a	n/a	
1970	6.9	93.1	100	10.1	89.7	100
1971	8.0	92.0	100	11.8	88.2	100
1972	8.7	91.3	100	13.8	86.2	100
1973	9.5	90.5	100	15.2	84.9	100

n/a: not available.

Source: Roskill Information Services: Ob.cit., pages 244-247.

The other important characteristic of the copper industry was that the geographic distribution of copper consumption experienced an important change as can be seen in Table 6.9.

Table 6.9

Copper Consumption in market economies:

Average rate of growth and market share of major copper consuming countries  
(percentage)

Countries	Rate of Growth	Market shares	
	1966-72	1966	1972
France	2.0	5.6	6.2
F.R. Germany	7.1	8.8	10.7
Italy	6.6	3.7	4.5
Japan	12.4	9.3	15.2
U.K.	-1.5	11.4	8.6
U.S.	-0.4	41.5	32.5

In this period, Japan and Germany continued improving their position as copper consumers in the market economies. Both countries used their better bargaining position and defined strategies which had important influences on the copper market.



These market conditions were the basis on which other important decisions were made in the copper market, both by copper consuming countries and companies other than those located in Chile, Zaire and Zambia.

6.2.6 Other changes in structure and the strategies of the private copper companies and the copper consuming countries

In 1966-72, outside the areas which nationalised their copper industries, important developments took place.

In the market economies, the copper investment to supply the international market (ex the U.S.) was orientated towards developed countries (Australia, Canada and South Africa) and to countries which were marginal producers or areas where copper had never been mined before.

ASARCO, Rio Tinto Zinc and Noranda consolidated their position in the copper market: marginal producers expanded and new companies entered into the copper market. The companies whose position had been deteriorated as a result of nationalisation started the search for alternative sources of supply, though their efforts were not successful in most of the cases.

These developments were consistent with the general strategy of the copper importing countries: diversification of their sources of supply and that these sources were as stable as possible. But it is noted that the countries in which copper consumption was more dynamic, Germany and Japan, implemented a strategy to increase their influence on the copper market.

ASARCO expanded production in Australia and in 1969 reached an agreement with the Peruvian government to develop Toquepala which reached production in 1976.

Rio Tinto Zinc expanded production in Canada and in 1969 reached agreement with the Australian government to develop the Bougainville deposit, located in Bougainville Island which was under the Administration of the Australian government at that time.

Freeport Mineral Co. a new entrant into the copper market made the definite decision of investment in the Ertzberg copper deposit, Indonesia, in 1969. This country had not mined copper before.

Noranda expanded capacity of production in Canada and through Placer Development Ltd., also invested in the Philippines.

Smaller copper producers also expanded in Canada, Australia and Philippines.

The Japanese had no direct investment in copper mining outside their territory but in this period the Japanese copper semi-manufacture industry started the implementation of a policy, with governmental support, to develop copper deposits overseas. This policy considered an intense programme of prospecting; a report states that the Agency for Promoting Metallic Minerals Prospecting had been engaged in 170 overseas projects to prospecting for copper or the development of copper mines (1) before 1973. The only important overseas investment in copper mining during this period was SODIMIZA, in Zaire; but they also began the development of a small copper deposit in Malaysia and another in Bolivia. The Japanese entered into overseas copper mining in this period.

The companies, which were partially or totally nationalised during this period, started to look for the possibility to regain their position in copper mining, though with different degrees of success. Anglo American has probably been the most successful, despite its failures in the development of the deposit at Akjout in Mauritania and that later had to postpone the investment at Tenke-Fungurume; but it could expand in Canada through Hudson Bay and established the basis to develop a deposit in Mexico. Anaconda, outside the U.S., signed a contract to give technical assistance to the government of Iran to develop a copper mine and to build an integrated processing plant. Union Miniere began the development of the Thierry mine in Oregon, a relatively small copper mine; Amax began the development of mining projects other than copper outside the U.S. Kennecott also tried to diversify geographically to Oceania, but these efforts were to be unsuccessful, and more recently to Haiti.

From the point of view of the leading companies in the international copper market, these firms are potential competitors which will use their experience and expertise to bring into stream mines from areas other than those in which they were nationalised. They are interested in regaining their position in the copper industry and are searching for the opportunity to do it.

During this period another important development began; it had the support of the major industrialised countries of market economy: the investment in research and development to mine the deep seabed of the Oceans was increased. As discussed in Chapter 2 and 5, most of the large

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(1) Fuji Bank Bulletin: Industrial Report, Copper. Fuji Bank Bulletin, April 1975, pages 75-77.

private companies engaged in copper mining are in the consortia which may start the exploitation of this new source of primary copper and other minerals in the next decade.

It is important to integrate into the analysis the change of another variable, whose implications were also discussed in Chapter 2, the change in the geographical distribution in exploration towards industrialised countries and the drastic reduction of these expenses in developing countries.

The strategy of the consuming countries also had an important impact on the copper market structure and behaviour of the participants. As buyers their relations are competitive, but as totally dependent on sources of supply and/or net importers of primary copper, they also have some common objectives: security of their sources of supply and to increase their flows of copper from stable areas; to diversify the origin of their imports and to avoid the use of producer power.

However, the copper consuming countries had different restrictions to formulate their policies: for instance, in most of the European countries already existed a structure of inter-relations among the different agents operating in the copper market, so that to adapt the structure of inter-relations to new conditions was more difficult. The situation was different in the countries in which consumption was more dynamic, Germany and Japan. The position of the latter was extremely favourable in terms that they were relatively small copper consumers in the 1950s but became the second most important in the market economies in the 1960s.

Partly due to this situation, partly to the role of the government in the coordination and support of the companies involved, the strategy of the Japanese was more integrated and used a greater variety of instruments than those of other countries.

Japanese sources define their copper policy as orientated towards:

- a) diversification of the source of supply.
- b) Development of new mines.
- c) Stockpiling to provide for essential requirements.

Only (c) was not implemented in this period. But this policy had also other characteristics which were not included in these reports.

1. Development of smelting and refining capacity in Japan. During this period smelting capacity increased from 350 to 800 thousand tons and refining capacity from about 450 to 1,000 thousand tons.
2. To give financial and marketing support to the mines which were to supply their smelters and/or refineries, especially when the location of the new mines were close to their processing centers. For example, the Japanese had an important financial and marketing role in the projects of investment in Indonesia, Papua New Guinea, Philippines, and also in Canada.

3. Provision of copper through long run contracts.
4. Direct investment by Japanese copper companies in other countries, that is, to enter into overseas mining operations. Either through the association of capital from different Japanese companies or through joint ventures with companies of other origin.
5. Participation of Japanese companies in research and development of the exploitation of the seabed.
6. Intensification of programmes of exploration in other areas.

The German strategy basically considered the same points but had three important differences, firstly, the government did not play a role as important as in the case of the Japanese; apart from the differences in conceptions this was due to the fact that the Germans were not new entrants to copper refining and this process was concentrated in two companies which also had a significant control of the copper semi-manufacturing of that country. Secondly, the investment in smelting, though important was much smaller than the Japanese. Thirdly, they did not directly invest abroad, though indirect investment had an important role, for instance in Indonesia and Mauritania.

Other copper consuming countries have basically the same objectives but they did not operate a policy as integrated as the Germans and Japanese.

Two additional considerations are necessary, both of them referred to the explosive expansion of the Japanese custom-smelter industry.

This was developed while capital costs were increasing and there was over-capacity in the market economies; the equipment of most of the Japanese competitors were relatively old and had been depreciated

so their cost was relatively low. At the end of the sixties the normal charge for treating concentrates was between 7-8 cents per pound but long contracts were considerably lower, 4-6 cents. The Japanese were operating in the lower range and basically on a long run basis. Thus, it can be said that the price difference was the cost to entry to the smelting - refining industry paid by Japan.

The second consideration, the strategy of the Japanese was supported by a technological development, the transport revolution of the 1960s. There is no information about the impact of bulk transport in the case of copper, but in the case of iron the average cost fell from 5.5 to 3.6 per ton from 1960 to 1969, there is no reason to suppose that the cost reduction in the transport of copper was different.

### 6.2.7 Evaluation

Which of the following list of factors was the most important in the process of successive changes which took place during this period?

- a) The market conditions prevailing in 1965-70.
- b) The total or partial nationalisation of the leading copper companies in three countries.
- c) The indefiniteness of a common policy by the leading private companies while they maintained the dominant role, 1966-69.
- d) The non-formulation of a common policy by the governments which nationalised their copper industries.
- e) The strategies of the copper consuming countries.
- f) The strategies of private copper producing companies other than those affected by total or partial nationalisation.

All of them had a relevant role and each of them interacted with the others. It is possible to say that a non-formulation of a common policy by the leading copper producers made easier the operation of the strategies of the copper consuming countries and the other copper companies, specially in the market conditions prevailing in this period.

As a result of the interaction of the different strategies the structure and behaviour of the copper industry experienced a drastic change. In Chapter 5, the changes in the structure were already defined, so they will only be summarised.:

- 1) Five leading copper companies experienced an important reduction of their market position. The operation of Anaconda and Kennecott were restricted to the U.S. market. Anglo American and Amax maintained a position of influence in their former Zambian companies through minority shareholding and marketing and managerial contracts; both companies improved their position in other areas though they were still marginal producers. Union Miniere also maintained a position of influence in Zaire by treating an important part of the copper produced in this area and through marketing and managerial contracts: Union Miniere became a custom-smelter without controlling any important copper mining activity.
- 2) The emergence of three State owned companies.
- 3) After the nationalisations the concentration of production by the ten largest producers fell in the international market but concentration is still moderately high (more than 70% in the ten largest producers in the market economies outside the U.S.)

4) The custom smelters became more important in the international market, either as a result of nationalisation or the strategy of the copper consuming countries, consequently the pattern of trade also changed, but augmenting the importance of concentrates in the total volume of the copper exports. The implications are several; only three of them will be defined.

4.1 The custom smelters have different operational characteristics and interest than the primary copper producers as will be seen.

4.2 The net income generated in mining countries was lower than it would have been, increasing instead the value added in consuming countries where the custom smelters are located. This situation affected both industrialised countries, Canada, and developing nations: Indonesia, Philippines and Papua New Guinea. The demand for building processing plants were to generate tensions between the private companies and the host governments in some countries.

4.3 The primary copper producers became a more heterogeneous group in the sense that they exported a product at different stages of elaboration and whose marketing characteristics are also different.

5) New entries in the copper industry.

5.1 New areas became exporter of copper. Papua New Guinea and Indonesia. In these countries, the governments became a relatively important agent in the formulation of copper industry policies.

5.2 Marginal producers expanded their output and exports: Philippines.

5.3 New companies became copper producers.

6) The substitutes of copper made an important inroad in the copper market.

7) The structure of consumption also experienced an important change in the market economies: the Japanese were the fifth largest copper consumer early in the 1960s and became the second; the Germans were the fourth and became the third. The position of the U.S. and the U.K. declined in relative terms.

The dynamics of the transformations which simultaneously took place during this period determined a complete change in the inter-relations of the copper producers some of which were significant in 1966-72 while others became more important after this period.

Chile, Peru, Zaire and Zambia organised CIPEC but they did not establish relations with other copper producers to adopt a market action or coordinate their policies. However, even if they had tried, it is likely their efforts would have been useless for three main reasons:

i) Different strategic considerations, to the other copper companies this was the opportunity to consolidate their position in the copper market.

ii) New copper companies and the governments of areas where copper production was to start or substantially increase had different interests to those of the traditional copper producing countries.

iii) The private companies were not interested in establishing relations with nationalised industries as far as the governments had not solved the problems of compensation: this is important because there were negotiations on compensation during the whole period and the non nationalised private companies had investments not only in copper but also in other minerals in other developing countries. To illustrate this situation, the Zairean experience provides a good example. The government did not want complete nationalisation of the industry and looked for other possible partners to reduce the powerful position of Union Miniere; among other companies Anglo American and Amax were interested in this attractive possibility but both companies, despite the potential benefits of an agreement with the Zairean government, conditioned any arrangement to the payment of compensation to Union Miniere.

The result was that the relations among copper producers became more competitive and the decisions more uncoordinated and as a result of these situations, the generation of over capacity of production which did not become evident in this period but after 1973, though it had been forecast in 1968-70.

The only mechanism of coordination of the producers was to sell the copper on the basis of the LME, despite the long run implications that the high quotations of this market were to have in terms of substitution, decisions of investment and new entries in the copper market.

The inter-relations of the copper producers became more complex in this period affecting the possibilities of producers coordination. Most of the factors operating in this direction have already been considered, however, another four may be relatively important to formulate a common producers policy in the future.

i) The primary copper producers were divided in two groups, the state and private owned companies. The lack of experience which affected the state owned companies during this period will be overcome by a process of learning by doing, however some structural operational restrictions will persist (see final pages Chapter 5), so it can be expected that the policies of these companies will be relatively inflexible to the changes in market conditions. A clear example is considered in the next chapter. Moreover,

coordination with other copper producers will also be affected by the fact that the state owned companies also use other criteria than profitability to make their decisions, social and political considerations may be determinant.

Private companies have more flexibility and they still maintain a system of inter-connections which may be relatively important to coordinate their decisions: however, the goals of host governments and the firms are frequently conflicting factor which also may have an important unstabilizing effect on the definition of a common policy.

ii) In developing copper exporting countries, the governments took a more direct role in the formulation and implementation of policies of the industry. This is self evident in countries where the copper companies were nationalised. But the same process took place in Indonesia and Papua New Guinea where the governments became minority shareholders and active agents in the industry.

The number of agents, with divergent interest, who would have to participate in the formulation of a common policy increased, making it more difficult to reach an understanding.

iii) In countries where copper is an important source of foreign exchange value added and government revenue, the market copper conditions have an important influence on the formulation and implementation of the policies of the Governments. Changes in the former may affect the latter (i.e. rate of exchange, imports restrictions, salary and wages control, etc) which in turn may affect the policies of the companies and the discipline of the copper producers.

Moreover, in countries where the major role is played by the private companies, the change in policies may affect the relation between the companies and the host governments.

iv) The fact that the copper companies started to market a product at different stages of elaboration also determines a different behaviour of the companies. This situation had an important role in the first attempt to define a common policy after the changes in the structure of the industry. This aspect is analysed in the next Chapter.

Finally, the custom smelters have to be considered in this analysis because their behaviour is different to that of the primary producers.



When the custom smelters operate on toll basis their profits are more dependent on the price and cost of the service they give than the price of copper. A reduction in the output produced may have an important impact on the cost of this capital intensive activity while the margin to absorb the additional expenses is more reduced than in the case of an integrated producer.

It is true that in the contractual relations between the primary producer and the custom smelter, there are some clauses which establish premiums related to the price of copper, but this does not invalidate the fact that the basic price of the service is independent of the price of the metal.

When the custom smelters buy the copper most of their costs are composed by the value of copper which is subjected to frequent changes caused by the fluctuations of the prices of the red metal. Therefore, their costs will tend to experience more frequent and drastic changes than those of the vertically integrated producers. So that if the producers' parameter of action is price, the custom-smelter will tend to change the price more frequently and possibly before the vertically integrated producers (1). If the parameter of action is not the price, the custom-smelters will prefer a relatively flexible system of price.

These different operational characteristics between the custom-smelters and the vertically integrated producers may have a considerable impact on the sellers' discipline. Two experiences reinforce this suggestion. The first was already considered in Chapter 4 in the analysis of Copper Exporter Inc.: during the first years of the crisis the U.S. producers were reducing output and threatened to take drastic measures if custom-smelters continued to buy copper from independent producers to compensate the lower flows of input. As the crisis became more intense and the U.S. producers decided on a more drastic restriction of production, custom-smelter increased the volume of secondary copper processed. The second example is considered with the analysis of the first collusive agreement after the nationalisations in Chapter 7.

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(1) B.R. Stewardson: The Nature of Competition in the World Market for Refined Copper. Economic Record, June 1970.

CHAPTER 7The Intergovernmental Council of Copper Exporting Countries, CIPEC7.1 CIPEC7.1.1 CIPEC: Its organisation and objectives

CIPEC was created in June 1967, that is, two and six years after the political independence of Zambia and Zaire, respectively and only a few months after the Zairean government had nationalised the copper industry and only one month after the Law of Chilenization of the copper industry was approved. Peru and Zambia had not yet decided on direct state intervention in their copper industries. There already existed some other organisations for particular raw material (such as the Organisation of Petroleum Exporting Countries, the International Tin Council and the Lead and Zinc Study Group).

As far as it was possible to determine, the creation of an intergovernmental organisation of the copper exporting countries was proposed in a report by the UN which referred to the economic and social conditions of Zambia at the time of independence (1). After considering the Zambian economy one of the recommendations made by the authors was the creation of one organisation to coordinate the copper policies of the four countries most dependent on this raw material.

The creation of CIPEC was decided when the President of Zambia visited Chile in November 1966. The joint declaration of the Presidents (2) stressed the importance that Chile, Peru, Zaire and Zambia had, both in world copper production and trade, and it pointed out that this characteristic clearly indicated "the possibilities which would be opened by a close relation between" these countries (3).

There followed a period of diplomatic consultations which ended when Peru and Zaire consented to attend a Conference with Chile and Zambia to discuss the common problems of their copper industries (4).

The first official meeting took place in Lusaka, in June 1967 where it was decided to set up an Intergovernmental Council of Copper Exporting Countries.

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(1) Report of the UN/ECA/FAO: Economic Survey Mission on the Economic Development of Zambia, Ndolo 1964.

(2) Engineering and Mining Journal, January 1973, page 131.

(3) Quoted from Jean d'Hainaut: The Birth of CIPEC. CIPEC Quarterly Review July-September 1976.

(4) CIPEC Quarterly Review "Tenth Anniversary Issue".

In the agreement reached by the four countries the orientation of the new organisation was defined by stating first that it was necessary to prevent excessive fluctuations in the price of copper and to maintain a fair price of copper for both producers and consumers, and second that price fluctuations could be reduced by increased cooperation and concerted action by copper exporting countries (1).

The following objectives of CIPEC were defined by the same document (2).

- to co-ordinate measures designed to foster through the expansion of the industry, dynamic and continuous growth of real earnings from copper exports and to ensure a realistic forecast of such earnings.
- to promote the harmonization of the decisions and policies of the member countries on problems relating to the production and marketing of copper.
- to obtain for the member countries better and more complete information and appropriate advice on the production and marketing of copper.
- in general to increase resources for the economic and social development of producer countries, bearing in mind the interest of consumers.
- to promote the co-ordination of their policies with other organisations of the same type as CIPEC.

The structure of CIPEC consists of three basic organs:

- a) The Conference of Ministers which is the supreme body of CIPEC and consists of one representative from each country who has generally been the Minister of Mines. Before the Conference of Lusaka of 1974 this body met in ordinary session every two years, since then annually. An extraordinary session can be called whenever it is requested by at least two members.

Each country has the right to one vote but unanimous decisions are required in any relevant subject.

- b) The Governing Board consists of two representatives of each country but each delegation has one vote. Its function are to coordinate measures related to the international copper market, processes of production, exports or consumption. This body has also to implement the decisions and policies formulated by the Conference of Ministers. It is also responsible for the Copper Information Bureau, the third body of CIPEC.

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(1) CIPEC Quarterly Review "Tenth Anniversary Issue". The first ten years.

(2) Year Book of International Organisations 1977, 16th Edition.

## c) The Copper Information Bureau -

It is headed by an executive director who is appointed by the unanimous vote of the Governing Board. The Copper Information Bureau prepare information on the market conditions and factors affecting the copper industry and their by-products.

7.1.2 Market Share of the member countries

In Table 7.1 the market share of the four initial member countries is presented: the information refers to 1966 because of the 8 month strike in the U.S. in 1967-68.

Table 7.1

Output and Net Export Share of the Four Initial Members of CIPEC

	(in percentage and thousand tons)						Net Exports c)
	Mining		Smelting		Refining		
	TW <sup>a)</sup>	ME <sup>b)</sup>	TW <sup>a)</sup>	ME <sup>b)</sup>	TW <sup>a)</sup>	ME <sup>b)</sup>	
Chile	12,3	14,8	10,6	12,5	5,6	6,9	26,6
Peru	3,4	4,1	2,6	3,1	0,6	0,7	7,7
Zaire	6,2	7,1	5,5	6,5	2,5	3,0	14,4
Zambia	12,1	14,5	10,4	12,3	7,7	9,5	27,0
TOTAL	34,1	40,6	29,1	34,4	16,4	20,1	65,7

a) TW : Total World

b) ME : Market economies

c) The socialist countries are considered as one economic unit.

Source: Based on World Bureau of Metal Statistics.

In 1966 the main copper exporting countries outsiders of CIPEC and their market shares of total net exports were as follows: Canada 11.3%; South Africa 4.8%; Philippines 3.4%; Australia 1.2% and Norway 1.1%. Any remaining countries had less than one per cent of the net exports. It should be noted that in Canada one of the two most important producers obtain its copper as a by-product of nickel, for this reason Canadian producers have never participated in a copper cartel or producer collusions, but have always behaved as a friendly outsider. Nowadays the copper obtained as a by-product of nickel must represent about 20 or 25 per cent of the Canadian copper output, that is, much less than in the past.

The market share of the outsiders of CIPEC, 34%, is large enough to determine that any market action that CIPEC would have undertaken required their cooperation, otherwise failure or ineffectiveness would have been the result.

In 1974, the original CIPEC's agreement was amended to provide for the admission of countries as associate members whose economies do not depend on copper exports to the same extent as the initial members. Between 1975 and 1976, four countries were admitted to CIPEC: Australia, Papua New Guinea, and Mauritania, as associated members, and Indonesia as a full member.

It should be noted that three of the new members did not produce copper in the 1960s and that the whole of production is concentrated: that Papua New Guinea is the only country whose economy is as dependent on copper as the original CIPEC members; and finally, that Australia is a developed country in contrast to the situation of the other members of CIPEC. Table 7.2 shows how the situation had developed by 1976.

According to the ownership of the means of production and form of state intervention, the CIPEC countries can be classified in three groups: majority ownership and important direct intervention: Chile, Mauritania, Zaire and Zambia; minority ownership, Papua New Guinea; mainly indirect intervention: Australia, Indonesia and Peru.

The admission of new members represented a small market share gain in terms of production, so CIPEC still requires cooperative behaviour of those outside the organisation. The most significant outsiders are Canada, Philippines and South Africa.

Table 7.2

Output and Net Export Share of the Countries Participating in CIPEC, 1976  
(in percentage)

	Mining		Smelting		Refining		Net Exports 1975
	WT	ME	WT	ME	WT	ME	
Chile	12,7	16,4	10,7	13,6	7,2	9,5	21,7
Peru	2,7	3,6	2,3	3,0	1,5a)	2,0a)	4,1
Zaire	5,6	7,2	5,1	6,5	3,4	3,6	11,9
Zambia	8,9	11,5	8,8	11,3	7,9	10,5	17,5
Sub-Total	29,9	38,7	26,8	34,4	20,0	25,6	55,2
Australia	2,7	3,6	2,1	2,7	2,1	2,8	4,0
Indonesia	0,8	1,1	-	-	-	-	1,7
Mauritania	0,1	0,1	-	-	-	-	n/a
Papua N.G.	2,2	2,8	-	-	-	-	4,7
Sub-Total	5,8	7,6	2,1	2,7	2,1	2,8	10,4
TOTAL	35,7	46,3	28,9	37,1	22,1	28,4	65,6

a) Production of 1975 because there were interruptions at the refinery state in 1976.

TW : Total World

ME : Market economies

Source: Based on CIPEC, Statistical Bulletin, 1976.

### 7.1.3 CIPEC and OPEC market shares

It is important to compare the situation of CIPEC with the market position that OPEC, the most successful cartel, had when it increased its price. It is not intended to give a systematic inter-industry analysis but to show that there are differences which determine different approaches to the price problem of both industries.

OPEC controlled 55% of the world production, and 66% of the output of the market economies in 1973 (1). The equivalent percentages for CIPEC were 35.7 and 46.3 per cent in 1976.

(1) The figures referring to the OPEC countries are based on Haim Ben-Shahes: Oil: Prices and Capital. Lexington Books. Toronto, 1976.  
N.H. Jacoby: Multinational Oil: A Study in Industrial Dynamics, MacMillan, 1974.

The OPEC exports represented 96% of total net exports while in the case of CIPEC they were 66 per cent.

The cost of production from new sources other than OPEC was substantially higher. When the price of oil was U.S. 3 per bl in the U.S. the cost from new deposits varied from 4 to 9 dollars, therefore there was no incentive to develop oil from other sources.

In the case of copper there are potential sources of supply outside the CIPEC countries which can be higher cost but in any case the difference in cost is not as significant as in the case of oil.

Oil has no secondary sources of supply while in the case of copper they represent about 15% of total output of refined copper.

It is also important to note that the cost of substitution of oil by other resources was higher than in the case of copper. Therefore the cycle of substitution takes a longer period in the case of the non-metallic product.

The cost of stockholding of oil is higher, requiring significant investment to be carried out; in the case of copper, it is relatively cheap.

The U.S. the largest importing country, imported about 37% of its oil requirements in 1973, about 19% of the net imports. The U.S. only imports 7% of its copper consumption which is not a significant part of the international trade.

For both oil and copper, Japan and the European market economies are marginal producers but important consumers and importers.

It is also important to note that all the OPEC countries were exporters of oil only, while in the case of CIPEC the relative importance of copper in total exports presents greater variations from one area to another.

#### 7.1.4 The actions of CIPEC until 1973

From 1967 to 1973, the role of CIPEC was to set up the organisation, to develop contacts with other institutions dealing with the copper industry, and to identify itself with the problems of the producing countries. Second, like other similar organisations, it has contributed to the standardization of the statistics on copper. Third, it has also been a center of discussion concerning the common problems that the member countries were facing furthering the development of mutual understanding.

Fourth, according to one of the CIPEC's publications (1) it has also participated in negotiations to modify clauses of the sale contracts considered unfavourable to the interests of the producers.

The first action of CIPEC was adopted when Kennecott Corporation began a series of court actions in Europe in order to obtain recognition as owner of the shipments from the nationalised mine of El Teniente (2). The proceedings created problems for the Chilean shipments and the possibility existed that the exports to Europe had to be restricted. In 1972, at the Conference of Ministers in Santiago, the four member countries decided to suspend all dealings with Kennecott Corporation as long as this company "persisted in its acts of aggression against Chile".

This resolution was important because the governments in CIPEC decided to cooperate with Chile instead of trying to erode its market share. Moreover, it set up a principle that developing countries would have to cooperate together when they were affected by retaliatory measures of multinational companies.

Despite the fact that some of the activities of CIPEC must have been secret, it is possible to say that there are important areas of policy not covered. Probably the most significant was the lack of definition of a common commercial policy of the members countries. This can be explained by the multiple changes which were taking place in the international copper market: the inexperience of the members countries, the lack of control of some of these countries on some of the decisions (Zaire and Zambia did not control the marketing of copper until 1974) and the importance of outsiders. But the more difficult the formulation of a policy is, the more necessary its definition becomes. This lack of policy will explain why CIPEC was always lagging behind events during its first market experience in 1974-76.

CIPEC did not undertake cooperative actions in a series of areas suggested by the communique of the President of Chile and Zambia in 1967 (3).

(1) Attraction of foreign capital in more favourable terms for producing countries.

(2) Marketing.

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(1) CIPEC Quarterly Review Tenth Anniversary Issue, 1977

(2) These actions started in 1972 in Europe, first in France and Sweden. In January 1973, court action was taken in the German Federal Republic but the court rejected Kennecott's claims. In March, Kennecott undertook similar activities in Italy.

(3) Engineering and Mining Journal, January 1967, page 131.



iii) Development of human aptitudes in technical and managerial professions.

It seemed evident that the CIPEC countries were to adopt common actions in those areas in which all the members had weaknesses and/or competitive disadvantages; research and development was one of them. All the four members are dependent on technology developed by the private companies and obviously they will remain in such conditions until actions start to be adopted if not to overcome the technological gap at least to reduce it; more evident is this sin of omission when it is considered that the state owned companies are three of the leading producers of the international market and that the private companies are cooperating in areas of common interest involving risk and heavy investment. Research and development has this characteristic for the three under-developed countries because they had to organise it and they have limited financial resources,

There are other areas where cooperation seemed important but no decisions were adopted to join actions: engineering, feasibility studies, exploration, etc.

It would have been important to the CIPEC countries to have undertaken cooperative activities, to have tried to solve common problems to learn to work together.

### 7.2 The CIPEC experience, 1974-76

In 1974-76 the only market action organised by CIPEC took place. The weaknesses of the member countries and some of the old conflict regarding areas of interest also emerged in this case.

This review of the market actions is sub-divided into three parts

- (a) analysis of the market conditions before the adoption of the decisions.
- (b) The CIPEC conferences, its strategies and quota scheme.
- (c) The situation after the agreement expired.

#### 7.2.1 Market conditions before the adoption of the decisions

In January 1973 copper prices began an upward trend, reaching the highest-ever level in April 1974. In 16 months the copper prices increased by 170% from 0.51 to 1.38 dollars a pound. That trend abruptly reversed and in the last month of 1974 prices had fallen by 57% with respect to the April levels. During this cycle operational costs had risen due to the energy crisis and world inflation. Table 7.3 summarises the quarterly movement of prices from 1973 to 1976.

Table 7.3

Average quarterly quotations of wire bars in the London Metal Exchange  
(cents of dollar per pound)

Year	1972				1973				1974				1975				1976			
Quarters:	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV			
Prices:	46	59	74	91	99	107	126	78	62	57	57	56	53	57	69	70	58			

In 1973 copper consumption increased by 11% in the market economies due to the high rate of expansion of economic activity in the capitalist countries: in some nations, like Japan the rise of copper consumption had the character of an explosion. The acceleration of the economic activity was accompanied by monetary disequilibrium which determined the closure for two weeks of the foreign exchange markets in the industrialised countries. An exogenous factor had an important influence on the outcomes: the conflict in the Middle East, the oil embargo and the subsequent oil price increase. Table 7.4 shows the rate of variation of industrial production and copper consumption in the developed countries with market economy.

Table 7.4

Annual rate of variation of industrial production and copper consumption,  
by country

Countries	(in percentage change from previous year)							
	1973		1974		1975		1976	
	I.P.	C.C.	I.P.	C.C.	I.P.	C.C.	I.P.	C.C.
Japan	15.6	23.1	-3.1	-18.2	-11.0	-12.1	13.6	21.3
France	8.1	14.8	2.5	-4.9	-9.1	-13.7	9.8	13.1
Germany	5.9	12.1	-2.4	-5.2	-6.1	-13.7	8.5	19.9
Italy	9.6	8.1	4.5	5.2	-9.3	-13.7	12.4	-15.7
United Kingdom	7.5	7.5	-3.6	-8.1	-4.8	-13.0	1.0	5.2
United States	8.5	6.8	-0.4	-9.6	-8.8	-26.0	10.2	20.1

I.P.: Industrial Production      CC: Copper Consumption

Sources: Based on International Monetary Fund: International Financial Statistics.

OIEPEC: Statistical Bulletin 1976.

Copper supply did not meet the increase in demand because a group of confluent factors.

- Strikes: In El Teniente, Chile, where there were also other conflicts which affected copper production i.e. truck drivers strike; there were also strikes in one of the Belgian refineries; at Toquepala, Peru and at Noranda, Canada.

- Delays in shipment, the already mentioned actions of Kennecott Corporation against CODELCO - Chile affected shipments of copper to Europe in 1972-73. In January 1973, Southern Rhodesia closed its borders, interrupting the shipment of the Zambian copper which had to divert the transport to the East and through Angola.

- In the U.S. some producers declared force majeure due to production difficulties or plant modification to comply with environmental requirements, both in 1973 and early in 1974.

- In November 1973 the Japanese smelters and refineries had to reduce production as a result of oil and energy shortages.

- In periods of monetary disequilibrium like those of 1973, operators of foreign exchange tend to buy minerals as a hedge operation pushing prices up.

In 1974 a recession began in the industrialised countries with market economies, affecting copper consumption especially in Japan. On the supply side there were increases of production in Australia, Canada, Chile and Zambia. Two other important factors heavily influenced the prices. Early in 1974, the U.S. General Service Administration was authorised to dispose of 240,000 tonnes of copper from strategic stocks. This action helped to reduce the prices in the international market by reducing imports.

In Japan, the monetary disequilibrium and economic recession affected exports and thereby industrial activity, causing a drastic reduction of copper consumption of 18 per cent. Japanese copper imports are much more inelastic to reductions because they are basically concentrates and blister which are purchased on a long term contract basis. Therefore, the reduction of consumption implied a substantial surplus which was estimated at 350,000 tonnes in 1974 by Japanese sources (1). In March the Ministry of International Trade and Industry began to authorise licenses for copper exports. From March to October, Japan exported 260,000 tonnes of copper: this amount was larger than the total Peruvian copper exports of 1974.

Another factor which helped to depress prices was the increase in the rate of interest in the market economies, so stocks held for speculative motives started to be sold. It is not possible to estimate the quantities

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(1) The Times, October 9th, 1974, 15b.

involved in these operations but they must have been significant. In May 1974, the Joint Statistical Committee of the International Wrought Copper Council forecast a copper surplus of 481,000 tonnes for the year (1). The only uncertainty about the magnitude of such a surplus was a possible strike in the U.S. when the three years' wages contracts ended in mid 1974.

#### 7.2.2 The CIPEC Conferences

In April 1974 copper prices reached their highest level: in the U.S. strategic stocks were being disposed of and Japan had started to export copper in substantial amounts for the first time since the First World War. In these circumstances the Minister of Mines of Chile, A. Yovani, stated publicly that Chile was to propose a price fixing system to the other copper exporting nations.

"I consider that if circumstances permit us to adopt a system which raises the price of copper, which fixes a minimum, which protects national interest, we will insist on such a formula" (2)

This was the first public announcement of a possible action by CIPEC, but it was made without previous contacts with any other copper producer. But the statement could not have been made at a worse moment, because it provided grounds for the actions of the Japanese and the U.S.

In June the CIPEC's Governing Body met in Lusaka. According to the opening speech of the Conference by the Zambian Prime Minister, the preliminary meetings had not reached agreement. On that first occasion Mr Chona stated that CIPEC approached the problems of stabilizing the prices of copper like a debating society instead of taking positive action. He also said "I am afraid that my government is finding it increasingly difficult to go on pouring money into an organisation that exists to churn out butter and sugar coated communiques" (3).

There were three main points on the agenda of that meeting: stabilization of the price of copper above a minimum level, acceptance of new members, and liaison between CIPEC and similar organisations (such as OPEC and other mineral producers and exporters).

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(1) International Wrought Copper Council, Annual Report 1974.

(2) The Times, April 3, 19h. April 18, 18d, 1974.

(3) The Times, June 26th.

Despite the fact that no representative mentioned any specific level of minimum price, one was persistently disclosed by the press: 800 - 850 pounds a ton (0.65 - 0.70 dollar per pound). An upper limit was not defined but all the member countries maintained that the level of prices prevailing early in 1974 were too high to both consumers and producers.

There were three basic problems that the CIPEC countries were facing; firstly, reduction of demand and Japanese exports which were accelerating the downward price trend in the international market. Any market action required negotiations with Japan which was not prepared to accept any solution without a reduction of shipments to them; however the most important suppliers of Japan were outsiders to CIPEC.

The second problem area was that an agreement on production curtailment had become more difficult because in Chile the technical problems and investment delays had finally been overcome in 1973, resulting in an additional capacity of production of at least 250,000 tonnes. As a matter of fact, Chile was increasing output by 20 per cent in 1974.

The third problem was to find a source of finance to compensate for the reduction in exports earnings.

The final communique at the end of the 3 day meeting in Lusaka did not suggest agreement on a concrete plan of action: "CIPEC has decided to coordinate completely the policy to be followed in the world copper market, a decision which is to be immediately implemented by means of a mechanism adapted to present circumstances" (1). The same declaration pointed out that CIPEC had approved the acceptance of new members.

After the Lusaka Conference, the executive of CIPEC reached an agreement with Japan whereby this country was to reduce its copper exports by half. Up to that time Japan must have exported about 200,000 tonnes, that is about one sixth of the level of its 1973 consumption.

The CIPEC countries sent a second delegation to continue negotiations with the Japanese. In November the Japanese Minister of International Trade and Industry agreed to stop the issue of licences for copper exports which was reinforced by a declaration in December where it was stated that they would not permit its resumption. In return, the Japanese obtained a reduction of the shipment by 15% from some suppliers.

But negotiations with Rio Tinto Zinc, one of the major suppliers of concentrates to Japan (through Lornex in Canada and Bougainville in Papua

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(1) The Times, June 27th, 23f.

New Guinea) continued in 1975. This company did not accept to reduce its shipments in spite of the pressures by both the Japanese and the CIPEC governments.

Most of the Japanese custom-smelters are integrated up to semi-manufacturing so they increased their exports of wrought copper. Reports on the copper industry suggest that the destination of most of these sales were subsidiaries overseas of Japanese companies connected through their parents to the custom-smelters.

Table 7.5

Japanese Exports of Wrought Copper  
(thousand tons)

Year	1973	1974	1975	1976
Copper	30.6	35.3	59.1	78.3
Copper Alloys	20.5	28.5	39.7	59.5
TOTAL	51.1	63.8	98.7	137.8

Source: World Bureau of Metal Statistics.

The efforts of CIPEC were successful in reducing the Japanese exports of refined copper but limited since those of semi-manufactured products increased.

It is noted that Belgium and Germany did not increase their exports of refined copper but those of semi-manufactured. In both countries the custom-smelters control a significant part of the wrought copper industry. This method permitted them to maintain a higher rate of activity at processing and at semi-manufacturing and to avoid problems with their suppliers.

In the negotiations with the Japanese four different categories of interest were involved: a) the custom smelters which are more concerned with maintaining their level of activity and do not bear the cost of stockholding. b) The Japanese government interested in maintaining good relations with raw material suppliers because of its high dependence on these types of commodities but at the same time it was also interested in defending the market position of the local smelters. c) The producers of concentrates and the government where this product is exploited, which want to keep up the flow of a commodity already sold. Finally, d) those producers whose output of refined copper is sold on an annual basis.

In October 1974 the CIPEC Conference of Ministers met in Lima. It was during this meeting that the news was spread, quoting the U.S. Embassy in Peru as a source of information (1), that OPEC was to give support financially to CIPEC. Later some cables suggested that 2 billion dollars had been agreed between both organisations, that amount was equivalent to 8 months production in the CIPEC countries. Information of the CIPEC -OPEC negotiations were extraordinarily confused; representatives of both organisations neither denied nor confirmed them. Most likely they took place but no agreement of any kind was reached (2).

According to an interview given to Metals Week by the Executive Director of CIPEC three basic strategies were considered (3) by this organisation: a) Production and/or export cutbacks. b) Price indexing instead of using the LME quotation to set the price of copper. c) Establishment of a buffer stock mechanism.

Mr Gueronik pointed out that all three alternatives had been approved by the CIPEC Conference but he added that indexing would be difficult to implement. Based on the later outcome this should mean that the CIPEC countries approved an export curtailment in the short term and negotiation with the consumer countries on a buffer stock system as a medium or long term solution.

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(1) The Times and New York Times, October 31st, 1974.

(2) The Times and New York Times, October 31st, 1974, November 20th, 21st  
Interview with the Zairean Minister of Mines by Reuter reproduced  
in El Mercurio 22 November. Metals Week October 29th, 1974 and  
November 11th, 1974.

(3) Metals Week, November 11th, 1974.

It was not until November 1974 that CIPEC announced a reduction of exports by 10% compared to the average monthly shipment of the preceding six months of 1974. This was equivalent to about 18,000 tonnes per month when copper stocks held by others than primary producers were increasing at least by 38,000 tonnes per month (1).

Outsiders to CIPEC had been announcing production reductions without mentioning the basis on which they were to be applied. Despite the fact that the published statistics on stocks are far from accurate, a rough estimate would suggest that 15% reduction in production would have been required to change the price trend. If a 5% cut in planned production and exports had been adopted in July, it would have been proved to be more effective than the 10% cut decided in November.

It is noted that 8 months had passed between the public statement of the Chilean Minister and the decision adopted by CIPEC. The delay may be explained by the interest confrontation among the members of CIPEC, their lack of coordination with the non-members of CIPEC, and the effect of exogenous variables such as the Japanese exports, the U.S. strategic stock disposal, and those stocks sold by speculators when the rate of interest was raised in the market economies.

In the LME prices stabilized at 55 - 60 cents from December 1974 to April 1975 but stocks continued increasing at the rate of 49,300 tons per month. In April CIPEC announced in Paris that production for export were to be reduced by 15% from the 11th of that month till June 1976.

Prior to any further analysis an attempt will be made to determine whether the CIPEC countries carried out their decision. As a source of information the statistical bulletin published by CIPEC will be used (2) but there are several methodological problems. First, to the new CIPEC members a lower production cut was approved so they are considered separately. Second, there are no accurate monthly statistics so the only possible way to determine the extent to which the agreement was carried out is by comparing the annual figures of production and exports of 1974 and 1975. But there is an additional problem, the first CIPEC agreement referred to a 10% export cut while the second mentions a cut of production of 15%; therefore, after the second announcement, it seems that the member countries could export the accumulated stocks without violating the pact.

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(1) It includes stocks in the LME, consumers and dealers in Japan, Germany, France, the U.K. and the U.S.

(2) CIPEC: Statistical Bulletin: 1976.



Table 7.6  
Copper Production and Exports by CIPEC and non CIPEC Countries, 1974-1975  
(in thousand tons)

COUNTRIES	Mining		Smelting		Refining		Total Exports				
	1974	1975	1974	1975	1974	1975	1974	1975	ZVaria tion		
<b>a) CIPEC Oldest Members</b>											
Chile	902	828	-8.2	724	724	538	535	-0.6	859	788	-9.1
Peru	213	176	-17.4	177	156	39	54	38.5	187	153	-18.2
Zaire	495	495	0	454	463	255	226	-11.4	483	493	+2.1
Zambia	698	675	-9.2	710	659	677	629	-7.1	682	640	-6.2
Sub-Total	2,308	2,176	-5.7	2,065	2,002	1,509	1,444	-4.3	2,211	2,074	-6.2
<b>b) New Members of CIPEC</b>											
Indonesia	65	64	-1.5	-	-	-	-	-	64	61	-4.7
Australia	251	219	-12.8	200	182	195	193	-1.0	132	149	12.9
P.N.G.	184	173	-6.0	-	-	-	-	-	192	170	-11.5
Sub-Total	500	456	-8.8	200	182	195	193	-1.0	388	380	-2.1
Total CIPEC	2,808	2,632	-6.3	2,265	2,184	1,704	1,637	-3.9	2,599	2,454	-5.6
<b>c) Non CIPEC Countries</b>											
Canada	821	769	-6.3	516	496	559	529	-5.4	627	635	1.3
U.S.	1,499	1,280	-11.7	1,496	1,358	1,940	1,609	-17.1	113	156	38.1
South Africa	179	179	-	148	153	-	-	-	90	93	3.0
Philippines	226	226	-	-	-	-	-	-	221	210	-5.0
Total Non CIPEC	2,675	2,454	-8.3	2,160	2,007	2,499	2,138	-14.5	1,051	1,094	4.1
TOTAL	5,483	5,086	-7.2	4,425	4,191	4,203	3,775	-10.7	3,650	3,548	-2.8

Source: Based on CIPEC Statistical Bulletin 1976

\* Information on constant smelter countries is incomplete in CIPEC Bulletin.

The results presented in part a) of table 7.6 do not permit drawing a firm conclusion about evasion among the CIPEC countries. But it is possible to say that the measure adopted was ineffective.

Considering the behaviour of the new members of CIPEC and the non-CIPEC countries the problems of coordination become evident. Only P.N.G. reduced exports and production. Australia, Canada and the U.S. cut output but increased exports. Indonesia, Philippines and South Africa maintained both output and exports at the same levels of the peak year of 1974.

Although the percentage in which the non-CIPEC countries reduced output was higher than the cut of CIPEC, the former increased their exports by 4.1% while the latter reduced theirs in 6.2%. This was mainly due to the different type of restrictions initially adopted (shipments in CIPEC, mining output in the non CIPEC areas).

The existence of this dual system of restrictions must have affected the mechanism of control. As a matter of fact during the first year in the press it was continuously stated that one group of producers or another was violating the agreement.

It should be noted that the countries which did not cut output were those with small market share, therefore an output reduction by the other suppliers implied a significant market share gain. In addition most of them are producers of concentrates so they have already sold their output; in this circumstance possibilities of retaliation are unlikely.

The combined effect of the decision of the copper companies was a reduction of mine production and exports in 7.2 and 2.8 per cent, respectively. But aggregate demand fell by 9.9 per cent. This kept prices at the relatively low level of 50 - 55 cents during most of the year and in June 1976 total visible stocks had almost doubled compared with 1974, as shown in Table 7.7.

In 1975, the transport problem of the Central African copper producing countries aggravated. This had a decisive influence on the agreement of the CIPEC countries and has been a factor influencing the copper market during the second half of the 1970s. To define this problem it is necessary to consider it in its historical perspective.

The Zambian transport difficulties have since its independence been closely linked to the political developments of Central and South Africa.

Table 7.7

Stocks of Refined Copper Held by Producers, Consumers and Exchanges

(Thousand tons)

End of period	LME	COME	US Refiners	Japan Refiners & Dealers	Other Producers	U.S. Merchants	Total
1970	72.2	16.2	129.5	26.6	289.0	-	534
1971	140.3	18.4	75.0	54.9	358.3	-	647
1972	183.1	52.4	90.3	43.1	393.2	-	762
1973	34.8	5.4	39.2	68.9	235.2	-	384
1974	132.6	39.2	137.6	130.8	290.1	-	730
January	166.8	47.8	172.4	138.4	277.9	-	803
March	175.8	54.5	215.6	160.5	271.3	-	878
June	294.8	61.4	245.4	163.4	282.2	-	1049
September	431.2	70.5	212.8	206.3	312.7	-	1234
December	503.8	90.7	236.5	235.8	302.5	-	1369
1976							
March	532.9	87.0	228.5	226.4	300.0	-	1375
June	536.9	102.6	185.2	206.9	300.0	200	1532

Source: Copper Studies, November 12th, 1976, page 3.

In 1965, the Rhodesian Railways (1) carried most of the exports and imports of Zambia. This is 1,500 miles route which connects the Copper Belt with the ports of Beira and Lorenzo Marques in Mozambique, passing through Southern Rhodesia. The railway was jointly owned by the governments of Rhodesia and Zambia.

When the Rhodesian white minority regime unilaterally declared its independence from the U.K., the Zambian government decided to reduce its dependence on this railway, using and developing alternative routes. In 1967, the railway company was divided and the Zambian Railways was created.

One of the alternative routes was the inter-connection of the Zambian, Zairean and Angolan Railway systems, terminating in the port of Lobito. In July 1966, the Portuguese, Zaire and Zambian authorities reached an agreement whereby the Zambians could use this system to export 40,000 tons per month, that is, about two-thirds of its requirements. However, the agreement was never totally implemented, due to security reasons the capacity of transport of the system had to be reduced, there were guerilla activity in Zaire, at least in 1967, and in Angola. Until 1973, only about 20% of the Zambian copper was exported through this line.

(1) An analysis of the multi-dimension problem of the dependence of the Zambians on the Rhodesian Railways in R.L. Sklar: Corporate Power in An African State. Chapter V. University of California Press, 1975.

The Zambian government started to implement programmes to use road routes. For this purpose the Zambian Tanzanian Road Service was created, a joint venture between the governments of Tanzania and Zambia and the Fiat Consortia. The most important route used was the 1,500 miles North Great Route which connects the Copper Belt to the port of Dar-es-Salaam. This is a road extraordinarily difficult to maintain due to seasonal rains. It also used the Great East Road which runs from Lusaka to Salima in Malawi which in turn is connected by rail with the ports of Macala and Beira in Mozambique.

As a long run solution the Zambians decided to build a 1,860 kms railway, connecting the Copper Belt to the port Dar-es-Salaam. The government of Tanzania and Zambia formed the Tanzania-Zambia Railway Authority (TAZARA). The project had financial and technical support from the People's Republic of China, which conceded a credit relatively favourable to the African countries: 500 million dollars, free of interest, payable over 30 years and the first payment is due in 1985.

Despite the enormous efforts and a substantial investment about 33% of the copper was still shipped by rail through Rhodesia in 1972, 25% was exported via the Benguela Railway; approximately 35% by road to Dar-es-Salaam and the balance using miscellaneous routes.

In 1973, the Rhodesian government closed its borders to Zambian traffic. This was in reprisal for guerrilla in Rhodesia government alleged to operate from Zambia. Due to international pressure, the Rhodesian suspended the decision but the Zambian government decided to divert its shipments of copper to the Benguela line and other routes. The approximate flow of the Zambian copper exports was as follows: 50% through Lobito in Angola, the remaining percentage through Dar-es-Salaam, Mombassa and Nacala.

In 1975, the Angolan Civil War intensified and the Benguela Railway was closed. The Zambian mining companies had to declare an initial 20% force majeure which was increased to 40% in October. The Zambians had to intensify the use of road routes to Dar-es-Salaam and Mombassa in Tanzania and Nacala and Beira in Mozambique. None of these ports had the adequate infrastructure to absorb the additional port movement. It was reported that the price paid by Zambia was between 6 and 8 cents a pound, that is, between 10 and 14 per cent of the average LME spot quotation of 1975. The Angolan situation also determined that imports had to be diverted from Lobito, located in the West Coast of Africa to any of the East ports the Zambians were using to export their copper. Losses of time and imported products and additional expenses for diversion unfavourably affected both the operational

cost of the industry and the volume of production.

To maintain the continuity of the analysis of the transport problem it is necessary to make reference to developments which took place after the CIPEC agreement expired. In mid-1976 the TAZARA line was handed over by the Chinese to the governments of Tanzania and Zambia. The new system started to operate the same year. In 1978, about 90% of the copper was exported by this way. However, the new route has been operating at a relatively low productivity: the TAZARA wagon time turn round was planned for 22 days but it was working out at 40 days (1). According to a report of the World Bank quoted in the press, the locomotives in service on the line fell from 71% of the engine capacity in December 1977, to 43% by May 1978, mainly due to inadequate servicing and maintenance (2). The port of Dar-es-Salaam does not yet have adequate infrastructure and productivity is relatively poor. These inefficiencies led to the accumulation of stocks of copper and shortages of some physical inputs.

In August 1978, it was reported that Chinese technicians were returning to tackle the maintenance and managerial problems of the TAZARA line (3).

In October 1978 the Zambian government decided to re-open the southern route through Rhodesia (4) causing bitter reactions in Mozambique and Tanzania, for the political implications of the policy reversal. Shortages of different types of products in a pre-electoral period, accumulation of stocks of copper were two causes of the decision but also a significant influence was the fact that the Zambians had failed to meet an International Fund condition, that they had to reduce the import pipeline by 15 per cent. Although copper and fertilizer were the only commodities officially mentioned in connection with the decision, this route also started to be used to transport other articles in acute shortage, including certain consumer goods. However, the capacity of the Rhodesian railway available to the Zambians must be limited because when the Benguela railway was closed the Zaireans diverted most of their traffic to this route.

The Zairean transport problem started in 1975, when the Benguela railway was closed. But Zaire had no alternative route in perspective as did Zambia. Initially they had to use a complicated system of transport by rail and river to Dar-es-Salaam and to Zaire's own port of Matadi. The

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- (1) P. Russell Transport from the Copper Belt. CIPEC Quarterly Review, July-September 1976. Financial Times October 19th, 1978, 4.  
 (2) Financial Times, July 25 1978 and Guardian August 1st, 1978, 5.  
 (3) The Guardian, August 1st, 1978, 5.  
 (4) Financial Times, October 7th, 1978, 1-2, October 9th, 1978, 2.

disadvantages of these routes were evident: copper had to be handled many times during the transfer of one system to the other, using inefficient handling equipment, and inadequate means of transport (1). The result was low productivity and important physical losses. Later they adopted a 3,360 kms rail route through Zambia, Rhodesia, Botswana and South Africa to the port of East London, which is more than two times the distance to Lobito, with the additional disadvantage that the latter was closer to the European ports.

When the Angolan war was ended, the relations between Angola and Zaire were at the lowest level. The Zaireans had supported one of the movements fighting against the President Neto: President Mobutu, in turn, accused the Angolans of assisting the Zaireans who invaded the Province of Shaba twice in 1977 (2) and 1978. Only in July 1978 both governments agreed to establish full diplomatic relations and to re-open the Benguela Railway in November (3). However the route has remained closed due to guerrilla activity in Angola.

The Zambians have made significant efforts and investments to develop new routes of transport for their exports and imports; the use of two of their oldest routes have been restricted by political developments in Southern Africa. The TAZARA line constitutes an important step to stabilize the flows of exports and imports but there are still significant improvements to be made to the efficiency at which the system is operating. It can be expected therefore that the transport situation will continue being an important determinant of the price variations in the international market.

The Zaireans, less affected in the past, are becoming more vulnerable since the Rhodesian conflict intensifies, and the Angolan route remains closed. Inadequate roads to distant ports would be the only alternative left to the Zaireans. It is very unlikely that the TAZARA line can absorb their copper production. If this is the case, the impact on the prices of the market would be significant.

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(1) P. Russell Transport from the Copper Belt. CIPEC Quarterly Review July-September 1976.

(2) The implications of the 1977 uprising in Shaba, see Metals Week, May 2, 1977.

(3) Financial Times, July 18, 1978, 3; the Guardian, July 18, 78, 7.

Having defined the transport problem of the Central African exporting nations it is possible to return to the situation prevailing in the international market by the end of 1975.

By the end of 1975, studies on short term trends on the copper market forecast an improvement in consumption, based on signs of economic recovery in the U.S., Japan, and some European countries. All the analysts announced an increase of the prices in 1976: Amalgamated Metal projected a price of 70-80 cents per pound; Chartered Consolidated 60 to 68; Commodity Research Unit 70; the World Bank 67; CODELCO-Chile expected prices between 70-90 cents a pound (1).

These studies also emphasised the Zairean and Zambian transport situation which was expected to cause reductions and delays of the shipments of copper from the Copper Belt. However, most of the studies based their price predictions on the assumption that CIPEC and other producers were to continue regulating their output.

In the market economies demand for copper increased: in the U.S. by 27.6% and by 26.9% in Japan while in the relevant market of the four original members of CIPEC, Europe, it only grew by 9.8%

In the U.S. all the copper companies, except Anaconda, began to increase output. Although Kennecott introduced a pricing formula relatively favourable to its customers, the prices set by the producers were higher than those prevailing in the international market. The U.S. became a market of easy penetration to suppliers of the international market.

Philippines, South Africa and other small producers also started to increase their output; the European custom-smelters began to operate close to design capacity.

In January the LME quotations began to increase, reaching almost 70 cents in April: in May, Chile announced that if copper prices remained above 60 cents per pound its mines were to resume full production after the 15% cut, agreed by CIPEC, had expired in June 30 (2).

In a public document it was stated later that to extend such an agreement would not have had any effect on the copper prices. therefore it was only going to reduce the foreign exchange income of the country (3).

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(1) Ercilla, Reportage Especial: El Cobre, Julio 28, 1976, Chile.

(2) The Times, May 20th, 21d.

(3) Mensaje Presidencial, September 1975-September 1976, page 311.

According to a statement of Mr. Soko, Zambian Minister of Mines, the decision had not been communicated to the other CIPEC countries beforehand "assuming that the press communique is correct, I wish to express my disappointment that Chile should have taken this precipitate action"(1).

The effect of the Chilean decision was negative from the point of view of the members of CIPEC as a whole:

- a) It was an invitation, if not a challenge, to increase production.
- b) It split CIPEC while they were negotiating the establishment of a buffer stock system with the consuming countries in Geneva.
- c) It affected the only basis of coordination of the countries highly dependent on copper exports.

The decision adopted by the Chilean government was influenced by several factors:

- i) The problem of the Central African countries was over estimated and the alternative transport options of Zaire and Zambia were not fully evaluated. This is clear in a publication which justifies such a decision "Chile opposed continuing the restrictions of output because most of the other members of CIPEC were carrying out the compromise without bearing any real sacrifice (sic): their problems of cost, production and transport made it difficult, if not impossible for them, to increase their production. Chile, instead, was making a significant sacrifice because its low level of costs, capacity of production, and the normal operational conditions would have made easy to increase production beyond the quotas imposed by CIPEC" and the article states that without any restrictive agreement Chile "will obtain an additional flow of foreign exchange, lower costs and, possibly a larger market share" (2).

The argument totally ignored or under-estimated the capacity of retaliation of the other copper exporting countries and the inter-dependent character of their decisions: if Chile decided to augment its output the other producers had no other alternative but to increase theirs.

- ii) The CIPEC agreements had made special concessions to the Chileans taking into account their new capacity (3). If the agreement had been renewed such a situation would have experienced changes during the

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(1) The Times, May 20th, 21d and May 21st, 19d.

(2) H. Castro: El Sector Minero, page 164 in Taller de Coyuntura, Universidad de Chile. Comentarios sobre la Situacion Economica, Facultad de Ciencias Economicas y Administrativas. Publication No.36, 1976.

(3) Mensaje Presidencial 1975-1976, page 312, Chile.



re-negotiation of the agreement in June because the arrival of new capacity was expected in Peru that year; a new copper mine, Cuajone, was to increase the potential capacity of this country by about 50%. Both the Chileans and the Peruvians were competing for the same markets in Latin America and the U.S. where CODELCO had already started to promote sales (1).

iii) A rapid recovery of the world economic situation was expected.

iv) In Chile the costs of production had not increased at the same rate as in other countries which was possible through the suspension of trade unions rights since the military took over the government in September 1973; this policy was accompanied by a drastic policy of salaries and wages constraint.

In comparative terms, the results of such a situation are accumulative through time because in other countries negotiations with the labour unions exist: therefore remunerations may increase in real terms or at least maintain their purchasing power.

Despite the fact that the comparison is affected by the exchange rate conversion used, rough estimates suggest that the cost of labour in Chile was about 75% of that paid by the African companies.

During this period the policy of the Chilean government considered devaluations equal or higher than the rate of inflation, at least every fifteen days. In Peru, Zaire and Zambia the rate of exchange was modified but at irregular intervals and in lower proportion than the rate at which the internal prices increased.

The different rates of exchange policies have a considerable impact on costs, considering that in all these countries inflation was running at rates well above 70% a year.

An additional explanation of the lower Chilean cost was the fact that the ores began to be extracted from the richest sections of the deposits (2). This is a mechanism used by all the copper mining to reduce their costs during the periods of low prices but within certain limits: an intense utilization of this method may reduce the life span of a deposit: to increase cost in future and/or to determine investments. It seems that CODELCO decided to adopt greater risks.

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(1) Mensaje Presidencial 1975-1976, page 315, Chile.

(2) Metal Bulletin: Chilean Costs Outlined, March 21, 1978, page 20.

v) Two situations had imposed additional pressure on the already difficult problem of Balance of Payments in Chile:

- a) In 1976, the government decided not to renegotiate the external debt. This arose because that in March 1975 seven countries (Belgium, Italy, Netherlands, Sweden, Norway, Denmark and the U.K.) had refused to meet the representatives of the Chilean Junta in the Club of Paris to renegotiate the external debt on the grounds of the violation of Human Rights by the Chilean Junta (1). In 1976, this government continued to meet as much opposition as the year before. The ratio amortization interests to exports was estimated at about 35% (2).
- b) On February 18, 1976, the U.S. Senate approved the cutting off of governmental sales of arms to Chile on the grounds of violations of Human Rights by the government (3). Other governments had adopted similar decisions so the Junta had to shift to more expensive sources of supply. This was important not only for the nature of the regime but also because of real and potential problems with the three border countries.
- vi) The government was using the expansion of the copper production as an index of the success of its policy (4).

In Japan, the custom-smelters reacted to the Chilean decision declaring that they were to maintain output restrictions but made it dependent on their supplier's reactions. Ministry officials, when asked if the ban on copper export licenses was to be maintained, declared that they "would take a prudent stand, since world copper demand has not yet recovered sufficiently and stocks of copper products remained heavy" (5). But in another part of the declaration it was pointed out that Japan feared that Chile might be asking Japan to increase imports of copper, adding that this might affect the other producers, both CIPEC and non-CIPEC.

Ironically, it was easier to obtain cooperation from a custom-smelter than from primary copper producers.

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(1) Keessing's Contemporary Archives, May 12-18, 1975, page 27, 123.

(2) Bank of London and South American Review: 1978, pages 456, 560.

(3) Keessing's Contemporary Archives, March 26, 1976, page 27646.

(4) Hoy, June 17, 27, 1976, Chile.

(5) The Times, June 15, 1976, 19d.

### 7.2.3 The Situation after the agreement

#### 7.2.3.1 The competitive relations among the copper producers

When the CIPEC agreement expired, all the suppliers increased their output. By the end of 1976 refined copper production was 224,000 tons higher than consumption, and mine production plus secondary copper for refining was 400,000 tons higher than demand. Prices remained at 70 cents in the third quarter of the year but fell to 58 cents in the last quarter.

The impact on prices was mainly due to the uncoordinated character of the producer's market decisions and the failure to renew the agreement on output regulation. In these conditions output restriction by any supplier implied giving market advantages to the rivals, so all of them decided to expand production.

For 1977, the studies on short term trends forecast a moderate expansion in consumption and an increase of capacity of about 300,00 tons. There were uncertainties about the evolution of the transport situation in the Central African exporting nations but the major problems were in process of solution, so a new year of over supply was expected. However, a prolonged strike of the U.S. mine workers was expected for July when the three years labour contract ended.

By the end of 1976, the 10th Conference of Ministers of CIPEC met in Santiago to discuss the orientation of this organisation of 1977. Once more the Minister of Mines of Zambia had the most energetic position calling for market action "the whole world is laughing at CIPEC due to its incompetence to defend our interests"(1). But the appeal for a restrictive scheme was a lost battle, the Chilean government had already announced its opposition to output regulations (2), the Peruvians were not to accept any type of agreement without the participation of the Chileans. No decision was adopted to cope with the situation of over supply. The final communique of the Conference stated that the members "confirmed the desire to persevere in the dialogue undertaken (with the consumer countries) within the UNCTAD and to participate the fullest in discussions aimed at an effective market stabilization agreement". The communique also stated that "it was essential to modify the current pricing basis in copper sales contracts". The Committee on Marketing Policy was to study the different alternatives and the Executive Director was to negotiate it with the consuming countries (3).

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(1) El Mercurio, December 3, 1976, 1.

(2) Mensaje Presidencial, September 1976, pages 311-316.

(3) CIPEC in 1976: The Organisation's Activities During the Last Year. Quarterly Review, January/March, page 16.

In 1977, except the U.S. and Zambia, the copper suppliers either maintained or increased production. The Chileans operated at full capacity, the Peruvian augmented output by 50%, the Zaireans by 10% and the Canadians by 8% (1). During the first months of the year prices of copper remained above 60 cents mainly for concerns about the U.S. strike.

Early in the second half of the year the U.S. copper companies reached an unexpectedly quick settlement with the workers at a cost considered high for the companies. Two confluent factors explain this situation. On the one side the U.S. companies were trying to stabilize their price above cost and to avoid operating at a negative cash flow. but such prices were higher than those determined by the extremely competitive relations prevailing in the international market: imports were increasing at a growing rate threatening the market position of the U.S. companies. On the other side the companies were preparing their next move: to demand an import quota to the U.S. International Trade Commission (ITC), so they required as much political support as possible, especially from the State of Arizona where most of the copper of this country is mined and where the Hearings of the ITC were to take place. This demand is discussed later.

In the third and fourth quarter the LME quotations fell to 54 and 52 cents, respectively. At such prices about 75% of the copper industry was operating at a negative cash flow: even in these conditions output was not reduced (2). The volume of stocks accumulated reached 45.8% of production against 19.3% in the early 1970s.

The intense competition in the international market determined a reduction of 25% of the prices in one year: mounting surplus stocks required financing and threatened to depress prices for a relatively long period. Intense rivalry was also forcing the suppliers to adopt short term measures to reduce cost: to extract the copper from the areas of highest grade ores of the deposits, a method which may cause significant increases of the cost in the future. Moreover, the forms of non-price competition, discussed later, were changing the long competitive position of the producers.

In 1978, about 350,000 tons of additional capacity were to reach the stage of production due mainly to increases in Iran, Mexico, Peru and Philippines. Iran a new entrant, was to start up in July 1978.

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(1) The percentages are based on Amalgamated Metal Corporation: Review of Non-Ferrous Metals in 1977. London January 1978.

(2) Amalgamated Metal Corporation: Ob.cit., page 11.

In December 1977, the Conference of Ministers met again, this time in Jakarta. The representative of the Chilean Junta opposed again to curtailments on the grounds that the Chilean mines were the most efficient of the world and CODELCO-Chile was making a profit, even at the depressed price of that year. However, a new development took place in this Conference: Peru, Zambia and Zaire issued a statement saying that they had agreed in principle to cut production. The final communique of the Conference reaffirmed the support to the integrated commodity programme being negotiated through UNCTAD (1) and to persevere in the dialogue with the consuming countries. However, the disagreements of the producers had considerably weakened their bargaining position.

In January 1978 UNCTAD officials called for producers to cut output to help boost the prices of copper (2). Representatives of the CIPEC countries met early in February in London, but the negotiations were suspended because Peru decided it could not participate in a curtailment scheme if Chile was not prepared to cut production as well (3). The same month the Executive Director of CIPEC called for an international scheme to increase the price of copper (4): producers started again negotiations and early in March SOZACOM, the marketing company of the Zairean government, announced on behalf of Peru, Zaire and Zambia, that these countries had decided to reduce production by 15% (5).

As usual the formula adopted was not publicly defined. Only on the basis of a statement by a spokesman of these countries it could be made clear that in the case of Peru the cut was based on capacity of production, so under the scheme this country was allowed to increase production by about 20,000 tons with respect to 1977 (6). Zambia and Zaire were to apply their cuts on planned output: the net effect of the decisions was to be an output reduction of about 50,000 - 70,000 tons, that is 4 or 5 per cent the 1977 output of these three countries.

However, the market was completely insensitive to the announcement. It did not react either when a strike was declared in Metallurgic Hoboken in

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(1) The Times, December 6th, 17e, 1977.

(2) The Times, January 31st, 26e, 1978.

(3) The Financial Times, March 2nd, 1978.

(4) The Times, February 14th, 23a, 1978.

(5) The Times, March 2nd, 1978.

(6) The 1978 Peruvian copper capacity was 430,000 tons. less 15 per cent result in 365,000 while its 1977 output was 343,000 tons.

March, directly affecting the Zaireans, or when that month the Zambians declared a 15% force majeure due to transport problems (1).

In April 1978 there took place the invasion and uprising of the Province of Shaba, affecting one of the major producing areas of Zaire; technicians were killed and 2,000 expatriates had to abandon the country; only a dozen expatriate and eight Zairean engineers remained in the copper mines. The minimum production loss has been estimated in 80,000 tons; but by the end of July the government stated that the mines would operate in approximately normal conditions for the remaining part of the year.

Due partly to this event and to the lack of statistical information the decisions of some of the CIPEC countries cannot be fully evaluated.

However, some general conclusions can be drawn. The first is related to the long period that a decision on curtailment is postponed when one of the large suppliers is opposed to it. There is no doubt that such a measure was evident to the protagonists; analysis published in 1977 defined curtailment as the only option to avoid drastic price reductions and even some of them criticized the attitude of the members of CIPEC (2).

Second, when the decision on curtailment was finally adopted by only part of the suppliers, it became ineffective not only because of the stocks accumulated but also because the cuts did not respond to the market requirements.

Third, intense competition caused the paradox that in conditions of low prices the suppliers maintained and even increased production due to the interdependent character of their decisions. The retaliatory reaction of the suppliers to the Chilean output expansion was an increase in production, instead of the price cut of the classical model of the theory of oligopoly; the retaliatory character of this decision is suggested by the fact that some of the suppliers were operating well below cost; even it has been suggested that some of them were producing "on a basis which caused a net foreign exchange drain" (3).

Fourth, the factors determining the behaviour of the Chileans were already discussed. But it is difficult to find arguments which suggest that the Chileans were better off after adopting independent action, each of the pro has its counter-argument, both of them difficult to evaluate.

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(1) Financial Times. March 31st, 1978.

(2) Metal Bulletin: Prain pre-empts the big show. Metal Bulletin, October 18th, 1977.

(3) Amalgamated Metal Col., Ob.cit., page 12.

The expansion of production permitted them to obtain lower unitary cost but at the same time induced expansion of output by all the major suppliers, reducing the price of copper and causing financial distress in all the producers and countries, including Chile. The lowest prices, at least until the end of 1977, did not determine important closures, according to the report of the Amalgamated, only about 300,000 tons in the market economies of which only 100,000 affected suppliers of the international market. (1).

Reports on the copper industry repeatedly stated that employment considerations were one of the determinants of the Chilean behaviour. However, this factor is not mentioned in the policy formulation of this government, and the policy implemented was in fact to cause higher unemployment in the Chilean industry. Low prices implied a significant reduction of the activity in the small and medium size copper mines which have relatively high cost; these mines produce about 10-15 per cent of the Chilean output but employ 25-30 per cent of the total number of workers of the industry. Prices of as low as 50-55 cents cause higher unemployment in this segment of the industry than a curtailment of 10-15 per cent in the high scale copper mines.

During this period the uncoordinated decision also led to other forms of competition which are incompatible with the principle announced during the nationalisations and the extension of the control of the copper industry by the governments of developing countries. This process is too recent to be fully evaluated but some of the characteristics can be defined:

- a) In 1975, CODELCO invested 40 million dollars in a joint venture with Norddeutsche Affinerie and Hüttenwerke Kayser to build up a continuous casting plant in Germany. The Chilean mines were to supply 60% of the input of this plant. The main objective of CODELCO was to safeguard part of the German market.

It is unusual that in an under-developed country a government owned company exports capital to an industrialised nation, especially taking into account the Chilean economic context, high unemployment, balance of payments deficit, etc. But more relevant is the fact that this investment could have been made in Chile, specially taking into account that this investment was consolidating the diffusion of a new process in industrialised countries. This would have been important to adopt in the copper exporting nations, specially if in the long run they are interested in integrating to semi-manufacturing. Continuous rod casting has become essential to produce semi-manufactured copper at low cost.

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(1) Amalgamated Metal Co., Ob.cit., page 11.

Zaire started to exert pressure in France to be included as a partner in another project. The Peruvians were also considering to follow this example (1). Zambia was reported to have been trying to reach a joint venture agreement with Thomson Brandt by the end of 1976; the Zambians finally did not enter into the partnership but gained the contract to supply the copper of this project. It is noted that this country exports wirebars; the new contract implies selling cathodes so a reduction of its vertical integration (2).

It is unlikely that this process will continue: because there is over supply of continuous cast rod in Europe and some plants have had to suspend operations.

b) An example of the intense competitive relations between the two Latin American producers can be found in their sale campaign in Brazil. In the first semester of 1976, CODELCO-Chile reached an agreement with the Brazilians to supply 100,000 tons of copper per year. A few months after this agreement the Peruvian and Brazilian Presidents met and reached a commercial agreement whereby Peru was to supply 35% of Brazil's copper imports: in exchange the Peruvians were to buy maize and soya: they also agreed to take steps towards the formation of binational companies in copper mining and processing (3).

As a result of these negotiations the Brazilians obtained their requirements of concentrates and blister to start the operation of a custom-smelter which will process most of the domestic demand.

Primary producers were also competing to supply concentrates for a new custom-smelter in South Korea (100,000 tons capacity) (4) and another in Taiwan (50,000 tons capacity) (5). That is, the primary producers were competing to consolidate the position of two processors which in turn will re export their production possibly to Japan.

The People's Republic of China, since 1975 (6), has been reported as looking for suppliers of concentrates and most likely that the primary producers have already reached agreement to supply concentrates to this country.

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(1) W. Page: An Exploration of Attitudes, Expectations and the Plans of some Southern American Mining Executives. Mimeo. University of Sussex, 1977.

(2) Copper Studies, No. 10, October 1977.

(3) Bank of London and South American Review: 1976, page 681.

(4) Copper Studies, May 10th, 1977, page 1.

(5) Copper Studies, May 10th, 1977, page 2.

(6) For instance: Copper Studies, March 3rd, 1975.



Thus in less than three years the primary exporting nations have taken another step towards the vertical desintegration of the copper industry in the international market.

c) The third form of price non-competition has been taking place in one of the weakest strategic areas of the under-developed countries exporting of copper: investment.

i) So far no important investment has been implemented by companies of these countries. International financial organisations generally insist that experienced mining companies have to be involved in the development of a project.

ii) Copper is a capital intensive activity and its direct impact on employment relatively low. Large investment in copper reduces the capital available in other sectors of the economy.

iii) The CIPEC countries have never defined a common policy on investment and within the countries the policies have been subjected to continuous changes, partly due to the lack of a common policy and the inter-dependent nature of their decisions, and partly due to the impact that the prices of copper have in their economic policies. Instability in their foreign exchange revenue leads to instability of their policies including those orientated to the copper industry.

Another factor is also on the background, world wide inflation. Conditions of over supply and a slow rate of growth of demand coupled with intense competition, have maintained the prices of copper at a relatively low level affecting the financial position of both the countries and the companies. To maintain their long run position the countries have introduced measures to encourage foreign companies to invest in undeveloped copper deposits (which in all the original members of CIPEC had been taken over by the governments). Other countries have been forced to follow such moves. These policies also have been orientated to attract the oil companies which since 1973 have been looking for areas in which they can diversify.

In Chile, a concession was granted to Noranda Mine of Canada for the exploration and exploitation of the deposit of Andacollo; the investment is estimated at 350 million dollars (1976 value) (1). The contract freezes the tax for 30 years and it did not include any type of clause related to environmental protection. Another agreement was signed with four companies for the exploration and commercial exploitation of the

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(1) Bank of London and South American Review, 1977, page 492.

the Quebrada Blanca deposit; the four companies are: the Superior Oil Co., of the U.S.; Canadian Superior Oil, McIntyre and Falconbridge Metal Mines of Canada (1). The Compania Disputada las Condes was sold to Exxon by the Chilean Military government; the price of the transaction would have been based on the assumption that the mine had 100 million tons ore reserves of 1.4%; according to Exxon the mine really has 1.0 billion tons (2); this may be considered a deliberate mistake to obtain capital from an oil company to develop Chilean copper deposits. It is also possible that Atlantic-Richfield, a U.S. oil company which has recently absorbed Anaconda and received oil drilling concessions in the Southern Chile, may also start copper mining in Chile (3).

In Peru, the state owned Mineroperu announced the mining projects which was to undertake in the next 10 years: four out of seven were development or expansion of copper mines (4).

However, the same year the most important of these projects were negotiated with a group of seven multinational companies which were to organise a joint venture for the second stage at Cerro Verde (expansion from 33,000 to 165,000 tons). The companies involved included Wright engineers, of the U.S.; Marubeni, Mitsui and Furukawa Electric from Japan; Kochner Industrie Anlogon, of Germany and Construzioni ed Empeardi of Italy: the value of the investment was estimated in 1.3 million dollars (5).

The government also began negotiations with other companies, Mineroperu (51%) and Southern Peru negotiate a joint venture for the development of the Quellaveco deposit (6). A Japanese consortia was negotiating the development of Michiquillay deposit (7). Overseas Mineral Resources Development of Japan was exploring the Cerrohuayco copper reserves (8).

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(1) Bank of London and South American Review, 1977, pages 269, 377, and 432.

(2) Las Raxones Ineditas de la Exxon, Hoy 25-31 Enero 1978, pages 27-28; Financial Times, December 22, 1977 and January 27, 1978, page 22a and February 24, 1978, page 25b.

(3) The Financial Times, February 24, 1978, page 25.

(4) Bank of London and South American Review (BLSAR) 1977, page 40.

(5) Bank of London and South American Review, 1977, page 280.

(6) Bank of London and South American Review, page 330, 1978.

(7) Bank of London and South American Review, page 528, 1977.

(8) Bank of London and South American Review, page 441, 1977.

In 1978, the Ministry of Mines announced that investments were to be made in the Antamina, Tintaya, Quellaveco and Beyovar deposits, involving 2.380 million dollars (1): none of these projects were included in the Programme of Mineroperu, so it is possible to assume that they have been negotiated with private companies.

In Cerro Verde II and in Tintaya Mineroperu has made concessions which until recently were considered unacceptable to the Peruvian interests. It is not insisting on managing either projects, restricting itself to taking a percentage of the project "representing the value of the concession plus the feasibility studies"(2). At least in Cerro Verde the private interests demanded the sole right on the marketing of the mine's output (3). Before the Michiquillay project was postponed (October 1978), a group of seven Japanese smelters (4) requested relatively important concessions which undermine the control which Mineroperu already had in the industry, apart of concessions not considered in the Peruvian legislation (5).

In Chile, and Peru these measures have been adopted within a more liberal policy towards foreign capital investment. The Chilean Junta approved the Decree Law 600 (July 1974) and the 1748 (February 1977) which have been considered one of the most liberal foreign investment laws in Latin America and possibly in the world (6). The moves of the Peruvians have been less spectacular in this sense, but the Finance Minister has recently stated that the government wants an open aggressive campaign to attract foreign investment. To implement such a goal he started negotiations with a group of "foreign investment bankers for a kind of consultancy deal, under which the bankers would advise on how to alter the legislation and what other measures to take to attract foreign capital" (7).

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- (1) Bank of London and South American Review, page 380, 1978.
  - (2) Latin America Economic Report, February 9, 1979, page 42.
  - (3) Latin America Commodities Report, May 12, 1978, page 71.
  - (4) Mitsui Mining and Smelting Co Ltd; Nippon Mining; Mitsubishi Metal Corp.; Furukawa Co.; Sumitomo Metal Mining Co. Ltd.; Dowa Mining and Nittetsu Mining.
  - (5) The list of concessions requested in Engineering and Mining Journal, January 1978, pages 41 and 131.
  - (6) R. Lindly: Chilean Economy, Copper Bottomed Optimism, Financial Times August 18th, 1978.
  - (7) Latin American Economic Report, February 9th, 1979, page 42.

In Papua New Guinea, the government introduced new legislation which reduces the tax and grants other concessions for future mining developments (1); this directly benefits the exploitation of the Frieda River copper deposit (under consideration by Mount Isa Mines) and the O.K. Tedi deposit (under consideration by BPH's subsidiary Dampier Mining Co. Ltd.; Amoco subsidiary Fubilan Co. Pty Ltd and three partners of Kupferexplorationsgesellschaft MbH) (2).

In Indonesia new incentives to promote foreign investment were offered; high level officials were assuring that new investment was to be welcome and protected (3).

The information about recent negotiations between copper companies and governments in other under-developed countries exporting of copper is poor, specially those referring to the Central African producers. However, in September 1976 the foreign companies nationalised under the Zaireanisation programme of 1973-74 were to have their former property restored to them, provided they offered 40% of the capital to Zairean citizens (4). In January 1977, President Mobutu promised potential Belgian investors in his country a state guarantee for any new investment. none of these measures directly affected copper mining but the direction is clearly defined (5).

It is too early to forecast any definite results from this process, but these developments are very important and require some general comments.

These policies are additional evidence of the inter-related character of the decisions of the copper exporting countries.

The concessions already granted seem generous and will determine a reduction of the return of foreign exchange per ton of copper exported. It is noted that in the most important copper deposits are participating multinational companies from different countries or several large corporations from one country. This suggests that it will be extremely difficult for the host governments to modify the concessions already granted without affecting their relations with the governments of different industrialised countries and different financial organisation associated with the multinational companies, their relations may become even more competitive in the

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(1) The list of concessions in Engineering and Mining Journal, January 1978, page 166.

(2) Engineering and Mining Journal, June 1977.

(3) International Herald Tribune, August 22, 1978.

(4) Keessing's Contemporary Archives, April 8, 1977, page 28,287.

(5) Keessing's Contemporary Archives August 11, 1978, page 29,287.

marketing of copper, specially as the 1980s approach when new definite decisions of investment will have to be made. It is likely, therefore, that any attempt to integrate the policies of the primary copper producing countries may require an understanding on investment and possibly on the treatment of the foreign capital. If this is so, the possibilities of an agreement are extremely small: the Chilean Junta does not accept any regulations which may prevent the arrival of foreign capital: in October 1976, Chile withdrew from the Andean Pact using as main argument its disagreement with the decision 24, which establishes limits to the profits that foreign investors could repatriate from member countries.

Most of the concessions of exploration and exploitation have been granted to relatively small copper suppliers or companies which had no other interests in copper mining. The relations between the governments and these producers (or potential new mining companies) have not been clearly defined yet. But it is clear that the host governments tend to loose the control they already had on the industry. This suggests that the reaction among the copper producers will become even more complex and competitive. This is closely related to the relatively liberal stand of the host governments in accepting new entrants and permitting marginal producers, to improve their market position. The market will become more competitive unless the host governments take a controlling share in the new ventures. It is noted that in the early 1960s a similar policy was adopted by the oil exporting countries, granting concessions to marginal producers or new entrants; OPEC evaluated the situation and concluded that the policy was suicidal for their interests because it tended to accentuate their competitive relations and was making more difficult the coordination of their decisions: governments of very different ideologies agreed to modify it.

d) In relation to the fourth area of non-price competition, the terms in which the exporting countries sold their copper, the information is very poor. Traditionally the selling agents meet to discuss the basis which will be used to negotiate with the major consumers. It would seem that this mechanism of coordination did not operate efficiently in this period and the agreements were not totally respected. However, there is no direct evidence on this.

7.2.3.2 The U.S. import quota and the break-down of the producer's price system.

In 1976-78 the U.S. copper companies tried to avoid selling copper below average cost: such a policy implies that the U.S. suppliers had to set their price well above that prevailing in the international market. During some months of this period the price difference was 12 cents: the cost of delivering copper from the international market to the U.S. is about 2.8 cents per pound (2 cents for delivery and transport and 0.8 to meet the U.S. import duty). The consequent increase of the U.S. imports forced the U.S. producers to cut output and employment and/or to reduce the price difference. In 1976 and in 1977 copper imports were 26 and 30 per cent, respectively: this against an average of 12% in the last 15 years. In the first semester of 1978, imports reached 290,000 tons which gives an annual rate of 600,000 tons, that is, about 50% of the U.S. copper production.

By the end of 1977, the 12 largest copper companies demanded an import quota for refined copper to the U.S. International Trade Commission (ITC) in addition to the current 0.8 cents per pound import duty: for the first year they requested an import quota equivalent to 198,000 short tons which would be allowed to increase by 2.5% per year. The main argument used by the companies was economic injury caused by imports.

In August 1978, the ITC agreed to recommend to the U.S. President that copper imports should be limited to 270,000 tons, for five years starting in January 1978, and that quotas should be operated on a quarterly basis, that is, limiting imports to one quarter of the total annual import restriction.

In November 1978, the U.S. President decided to reject the recommendation of the ITC, possibly based on the political impact such a measure would have caused in the copper exporting nations.

If the recommendation had been accepted, the most affected would have been Canada, Chile, Peru and Zambia which were selling between 10 and 15 per cent of their exports in the U.S. Taking as a basis 1977, about 60,000 tons would have had to be diverted to the international market: about 2.5% of the net exports in the market economies: using as a basis the annual rate of imports of the first semester of 1978, about 10 to 13% of the net exports. Other factors constant, the import quota would have resulted in an additional price reduction pressure on the prices of the international market, whatever the short term price elasticity of demand is within the range 0.1 - 0.5 as estimated by econometric studies.

In May 1978, Kennecott announced a change of policy, its price was to be based on the future quotation of the New York Commodity Exchange which is basically the same as LME. In August Anaconda followed this move; ASARCO and Phelps Dodge maintained their producer's price, but following closely those of their rivals, that is, the quotations of the marginal markets.

The objective of Kennecott to counteract the increasing inroad of the copper imports in the U.S. market: these were becoming the most important determinant factor in the producer's price policy.

The decision of the two major U.S. copper companies meant the collapse of the producer's price, at least for the time being: that system had been used for more than one century except during the two World Wars and the war of Korea. The new system implies that the commodity exchanges are the basis of the copper price of almost the total output of the market economies. It can be expected that the U.S. prices will experience greater and more frequent variations than in the past, and that imports will drastically fall with respect to the first semester of 1978 but that the market will be more competitive.

#### 7.2.3.3 The stockpiling systems supported by the government of consuming countries.

In December 1973, the U.S. Congress authorised the realisation of all the copper held in the strategic stockpile. The remaining 230,000 tons were sold in 1974.

In 1976, the U.S. government revised the strategic stockpiling policy and a goal of 1,180,000 tons of copper was set: in terms of value, this stock was to represent about 10% of the total value of the strategic stockpile: in terms of quantity, about one-sixth of the market economies copper output.

Purchases against this goal have not been scheduled: it would seem that the U.S. General Service Administration budget does not include provision of funds for copper purchases yet: however, it has been expected that 200,000 tons would be acquired with funds from sales of tin: these purchases would be spread over a period of two years.

As a result of the negotiations between the Japanese government and CIPEC, the former limited the exports of unwrought copper and stocks began to be accumulated. The custom-smelters began to press for funds to finance the stocks. In 1976, they reached an agreement with the government.

The Stockpiling Foundation was set up as the organisation responsible for the operation. The finance was provided by the private banks, but it had governmental guarantee and part of the interests were subsidized. The government also authorised the purchases and sales from the stockpile. The total stocks accumulated are about 50,000 tons. The custom-smelters have continued pressing for additional funds which may be increased.

In 1975, the French government provided about 50 million dollars to the Groupement d'Importation des Metaux for the establishment of a stock pile. This is an organisation of the French semi-manufacturing industry whose main objective is to import metals for the French industry. In 1970-76, between 40 and 60 per cent of the copper imports were made by GIRM. In 1978 there were announcements that additional funds were to be provided for stockpiling.

In West Germany, stockpiling will also be implemented, so far the dominant criterion is that the bulk of the responsibility must rest with the industry, and the government had to subsidize the financing of the system through tax concessions (1).

The stockpiling system supported by the governments of the consuming countries in operation are too small with respect to the total consumption to have an important impact on the market.

However, those to be formed in the U.S. are relatively important; the fact that Japan and France may increase theirs, and that other governments may also set up theirs, is a situation which may have a significant impact both on the structure and on the behaviour of the industry.

In the late 1940s and early 1950s, when the U.S. government formed the strategic stockpiles, the policy of acquisition had a substantial effect on the structure of the U.S. and international copper industry, they permitted the entry of ASARCO in copper mining, reinforced the position of other smaller copper producers and reduced the market share of the leading primary producers. In the early 1980s this policy may well be orientated to support deep seabed mining accelerating the diffusion of the new processes of production.

This may be even more important if the consuming countries coordinate their stockpiling policies. Deep seabed mining is an area where the industrialised countries have been coordinating their policies since the

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(1) The Financial Times, November 30th, 1978.



mid 1960's. Alternatively these policies may be orientated to support the development of new sources of supply, weakening the position of the copper exporting nations.

### 7.3 Summary and conclusions

So far the CIPEC countries have not integrated their policies and no important action has been implemented.

Different factors have determined this situation since the creation of this organisation. In 1967-73 neither the leading private companies nor the governments were entirely in control of the most important copper companies. This was in a period of uncertainty caused by the negotiations leading to the process of nationalisations; the drastic changes of structure nationalisations implied with the consequent process of readjustment in turn caused a process of continuous changes in the policies of the producing countries. The structural disadvantages of the CIPEC countries (financial deficits, lack of experienced managers and technicians, important investment and structural changes in activities related and not related to the copper industry undertaken by the governments during this period) determined that a substantial part of the efforts of the governments had to be made to cope with the operational problems rather than with long run strategic considerations.

The process of nationalisation was an opportunity for those importing countries without access to the copper resources to increase their influence on the market; the companies not directly affected by the nationalisations tend to exploit the weaknesses of the leading suppliers; such behaviour led to additional changes in the structure of the industry (see 6.2.6 and 6.2.7).

Some analysts have inferred that collusion was unnecessary in the earlier part of this period because the prices of copper were too high. Here it is suggested that the policies of the consuming countries, marginal producers and new entrants were made easier because of the price policy adopted by the leading producers, the low level of collusion in the selling market and the lack of integration of the policies of the four original members of CIPEC.

The only action implemented by CIPEC started when the process of nationalisation was concluding. It was preceded and prepared in a period of considerable market disequilibrium and economic instability in the countries with market economies. It operated in a period of recessing inflation and when the importing countries were adjusting their policies to the new conditions, so indirectly affecting the copper market.

CIPEC had to widen its bases and to negotiate first with at least one consuming country before adopting a decision to influence the prices. This reflects how unprepared the organisation was to cope with its major objective (to stabilize the price of copper) and the fact that the industry had become

less concentrated, more disintegrated and complex. The time lag determined that when an output curtailment was adopted the prices were relatively low; moreover the production cuts were not large enough to accomplish their objective. The prices increased but only when consumption started to recover unevenly in the market economies.

Several areas of interest confrontation among the participants in the market become evident during the organisation and implementation of the agreement. They were relevant in different times but the result was to make more difficult the operation of the agreement. The most important were the following: exporting and importing nations; members of CIPEC and outsiders of this organisation; primary producers and custom smelters; vertically integrated suppliers and producers of concentrates; exporters with and without new capacity reaching the stage of production. However the increase in the differences of cost of production, caused by the transport problems of the two Central African exporting nations, was the major reason why the Chilean government did not renew the agreement nineteen months after being adopted.

As a reaction to the decision of the Chilean government all the suppliers but Zaire increased or maintained production, and a process of intense competition started in which the prices were driven below the average cost. Only after eighteen months the highest cost suppliers agreed to reduce production without the participation of the largest exporting nations.

The financial position of all the companies operating in the copper market was considerably affected by the persistence of the recession, the intense competition and the cost increase caused by the inflation in the market economies.

This was one of the causes of the process of mergers and take overs involving most of the major private copper mining companies (see 5.6.2.2.). Such a process had not concluded in the last year covered by this study.

The ownership structure of the three state owned companies was not modified. But it was the government of one of the lowest cost producing countries who introduced a change of strategy. The new policy was intended to attract foreign capital to bring into production undeveloped deposits on the basis of liberal policies and tax concessions. The other developing nations exporting copper made similar moves. Most of the companies which were granted mineral concessions are marginal copper producers or newcomers.

The process of intense competition made easier, if not encouraged, the installation of new custom-smelters, and some of the exporting nations also started to support the installation of a new process of production

(continuous casting) in the importing nations.

It is unlikely that a new market action will be organised by the CIPEC countries in the foreseeable future:

- a) The cost differences are still a relevant factor.
- b) The balance of payments of the CIPEC countries suggests that they will continue using short term considerations to make their decisions.
- c) It is likely that a joint market action will require an understanding on investment and on the treatment of the foreign investment among the CIPEC countries. The attraction of foreign capital has been one of the basis of the economic policy of the Chilean military government who will not accept discussion on this ground.

The independent policies adopted by the CIPEC countries contrast with the behaviour of the private companies and the government of the consuming countries. The latter are operating in a more competitive context, a larger number of companies from a large number of countries are competing for the access to the richest copper reserves. French, Japanese and West German companies are relatively new in exploration and development of copper deposits; the Belgians are trying to become more independent from the Zaireans, the U.K. corporations have been relatively successful in improving their market position, the Canadians are investing abroad to improve their competitiveness; the U.S. companies to regain the position they already had in the copper market and to supply their domestic market.

The private companies organised joint ventures in exploration in new and traditional areas; in research and development to exploit the seabed; associate their capital to improve their bargaining power in deposits which require large financial commitments and/or to invest in areas considered unstable.

The governments of the consuming countries continuously evaluate their policies of support for overseas exploration and development. They have had to compete more intensively for other resources, developing some general criteria and common basis of understanding. In addition their control of the technology and financial resources give them bargaining power and more flexibility in the implementation of their policies.

An integration of the copper policies of the under-developed countries exporting copper would require a relatively long period and its implementation would be limited for the compromises already acquired by the host governments. So it can be expected a relatively low level of collusion among these countries.

However, the relevant question remains: whether the developing nations exporting copper have the potential force to implement a market action or not.

The historical performance of CIPEC suggests a categoric no. But some of the factors interacting in the past will not operate in the future: the nationalisations have already been implemented, the large producing countries have accumulated some experience, the net export market share is relatively important in their relevant market; their reserves will supply most of the copper requirements of the market economies outside the U.S., and probably a growing proportion of the U.S. consumption. The decisions of the suppliers of the international market and those of the governments of the copper exporting countries are still independent.

A general answer on the basis of the analysis of the factors limiting monopoly power will be attempted in Chapter 8.

CHAPTER 8The Possibility of Success of a Collusive Agreement  
and the Degree of Collusion in the  
International Copper Market

This final chapter is an attempt to define the possibility of success of a collusive agreement in the international copper market on the basis of the factors determining monopoly power as suggested by economic theory and the lesson drawn from the study of the collusive agreements in the copper industry.

Monopoly power is determined by three categories of factors: barriers to entry into the industry; the possibilities of substitution of the commodity in consideration and the factors limiting coordination among producers.

It is difficult to specify the possibility of success of a policy of concerted action which is not being implemented, especially in a market in which the exporting nations have not defined a common strategy and in the recent past they have persisted in adopting atomistic policies. Moreover the discussion is indeterminate within a wide range of possible solutions. However several useful observations can be made and the options open to the producers assessed.

The analysis is based on the assumption that the nucleus of the collusion are the developing nations exporters of copper and their objective the stabilization of the prices. However, stabilization is not conceived as an objective per se but as a mechanism to improve the basis of the decision making process and to enhance the benefit the countries obtain from the industry.

The prices of copper are subjected to drastic fluctuations caused by the inelasticity of demand in the short term; the rigidities to adjust production in the short run and the long period required to bring into production a new mine or increase capacity in existing facilities and the cyclical behaviour of the demand for copper. Producers coordination can not totally eliminate the price fluctuations; even during the most successful collusive agreements the prices of copper experienced important changes; but it can influence the level at which the prices fluctuate.

The characteristics of the international copper market suggest that the only mechanism with any possibility of succeeding is an explicit understanding. Other mechanisms of producers' coordination are unfeasible options. This is the case of producers leadership because in the international market there is neither a dominant company nor a producer with a market share large enough to impose discipline on the other suppliers; moreover, in the new structure of the copper market the tradition of cooperation is relatively poor among the leading suppliers. The cost plus alternative, which basically consists in adding a percentage as return to capital to the operational costs, is also considered unfeasible due to the cost differences among the large suppliers.

To determine the possibilities of success of a policy of concerted action, the strategy of several agents are important:

(i) the governments of the copper exporting nations; (ii) the state owned companies; (iii) the private mining companies; (iv) the custom-smelters and the semi-manufacturing industry; (v) the governments of the importing nations.

All these agents are few and their decisions inter-dependent, so the modification of the strategy of one of them tends to cause reactions from the others.

The governments of the largest copper consuming countries, the semi-manufacturing industry and/or the custom-smelters define their strategy taking into account the policies of the producers. It can not be expected passive reactions; this does not necessarily mean they will react against the policies of the producers but they will try to operate according to what they consider their best interests.

The favourable or unfavourable reaction of the copper consuming countries will depend upon the particular strategy adopted by the exporting nations: if they adopt a joint co-operative market scheme the level of stabilization chosen will be an important consideration. However, the policies of the under-developed countries exporting of copper towards the private mining companies will be an important element of this equation; the consuming countries implement their policies of access to industrial raw materials on the companies based on their countries (this does not imply that the governments of the consuming countries support all the policies and actions of the companies).

### 8.1 Barriers to entry

There are three relevant barriers to entry into the industry: the access to the copper reserves, the financial requirement and the economies of scale.

#### 8.1.1 The access to the copper reserves

The developing countries exporting copper control about 70% of the copper reserves located outside the US and the Centrally Planned Economies. Seventeen percent is controlled by developed countries, Canada being the most important and to a lesser extent Australia and

South Africa. The balance is located in developing countries other than existing exporting nations, of which Mexico and Panama are the most important.

About 80% of the reserves available to the international market are located in countries which are exporting copper and probably 8% in nations which will become exporting nations, the balance are reserves which can not support important expansion of capacity of production.

The reserves of the developing countries will supply a substantial part of the additional demand and those of the few existing copper exporting nations most of the future requirements of the international market.

The number of both copper importing nations and companies have augmented, increasing competition for the access to the copper reserves. This situation will become more evident after the recession of the 1970s because new investment in mining capacity expansion has been suspended since 1974.

During the slump of the 1970s the developing nations adopted liberal policies on mineral concessions to attract foreign capital to improve their market position. Marginal producers and new entrants have been granted concessions to develop new deposits.

Although the bargaining position of the private mining companies was considerably improved by the uncoordinated policies of the exporting countries, they have adopted strategies based on long run considerations. Companies from different countries are joining their capital to exploit copper deposits which, for their importance, require a significant capital commitment. This policy has several objectives: to reduce competition for the access to the copper resources; to spread risk and to improve their bargaining position,



to make more difficult the threat of nationalisations or drastic changes of the investment agreements since a host government would face the risk of affecting its relations with several industrialised countries simultaneously.

The policies adopted by the governments of developing countries respond to short term considerations. It is important to consider this statement analytically.

Depending on the assumed rate of growth the demand for copper will expand on average by 300,000 to 500,000 tons per year in the market economies. The lower figure is greater than the 1976 Peruvian production and the higher figure greater than the Zairean output. To supply such additional demand the reserves of the developing countries will be essential.

This is more important if it is taken into consideration that in the 1960s the private mining companies invested in industrialised countries and brought into production mines of relatively low copper content due to the unstable relations between host governments and private companies in some of the developing nations. The implementation of such strategy is more expensive in the current context due to the anti-pollution legislation and the higher prices of energy and because the companies are more aware of the risk of intense competition in periods of recession.

Ironically, in such conditions the developing nations have been making access easier to their copper reserves for the foreign companies.

#### 8.1.2 The cost of capital

The capital cost to build a vertically integrated operation from mine to refinery was about 6,000 dollars per ton in 1976. Half of the amount corresponds to the investment at mining

whose time of gestation is relatively long, three to six years. At smelting and refining the investment requires a shorter period, three to four years.

Projects of this magnitude are subjected to operational, economical and political risks. Operational because there have been cases where the technical problems of exploitation have not been possible to be overcome once the investment has been made as in the case of the nickel-copper deposit developed by Anglo American Company in Mauritania (1). Economic, because it is difficult to forecast the changes in the market conditions during the period of gestation of the project, for instance, the nominal and real values of the investment may change considerably; the project may also reach the production stage during the down-turn of the economic cycle as it has been happening to those reaching the market after 1974. Political, because the institutional conditions may experience substantial changes in the area in which the projects are implemented; Mikesell states that the project of investment in Bougainville assumed that the island was to continue being an Australian protectorate for at least 10 years, but when the mine had just been brought on stream that territory became a part of Papua New Guinea, and the contract of investment had to be renegotiated with the new authorities.

The existence of custom-smelters has reduced the height of this barrier to entry, since newcomers may reduce by half the investment per unit of output. This alternative must be attractive when the investment has to be made in unstable economic and political areas. But it is also important since concentrates are sold on long term contracts, reducing, therefore, the impact of the uncertain reaction of the rivals.

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(1) Copper Studies: Company Profiles: Charter Consolidated Copper Studies. December 2, 1977, pages 1-6

### 8.1.3 Economies of Scale

The US Bureau of Mines estimates that at mining, the optimal scale of production is 180,000 tons per year in an open pit of 1% copper content. This is equivalent to about 3.8% of the volume of production of primary copper in the international market, a proportion which may have a considerable impact on copper prices due to the low elasticity of demand in the short term, assuming that the existing firms maintain their production.

The characteristics of some deposits may permit the entry of smaller scales of production without affecting the financial position of a new entrant, but this can not be considered as a general pattern. The relevant features of the industry are the decline of the copper content of the deposits and that the minerals are becoming increasingly complex, so it can be expected an increase of the economic scale of production, but it is not possible to predict at what level.

It was not possible to find information on the minimum scales of production at smelting and refining but they would probably be in the range of the 150,000 to 200,000 tons. Their size may also tend to increase, due to greater restrictions on environmental contamination and the greater complexity of the mineral processed.

### 8.2.4 Substitution

Aluminium, stainless steel and plastic have been traditional competitors of copper, aluminium being the most important.

The magnitude of the inroads of aluminium in the copper market during the 1960s and early 1970s was analysed in Chapters 2 and 6. The information available suggests that in other countries than the US, there is still a potential market that aluminium will capture. In the US where the relation of prices between both products was less

unfavourable to copper, and the price of copper more stable, the substitution of copper by aluminium was more intense than in Europe in several types of cables and wires. But it was not possible to determine the magnitude of the potential market that aluminium can capture from copper.

Nevertheless, some competitive advantages have shifted to copper after the energy prices increase. Aluminium requires about five times more energy per unit of output than copper. Moreover, a cable of aluminium requires a greater sectional area than copper, to obtain the same electrical conductivity; thus a greater amount of material of insulation to cover the greater aluminium surface; prices of plastic were also raised as a result of the increase of the price in oil.

### 8.3 Factors limiting concerted actions

Several factors limit the degree of collusion that the producers can attain in a market, namely: the number of companies in the market, the level of concentration of the seller market, the homogeneity of the product, the market share differences of the producers, the level and structure of cost and the fluctuations of demand. Possibly with the exception of seller concentration, these factors are neither a sufficient, nor a necessary condition to attain a high degree of collusion.

If the buyer market is relatively concentrated, the consumer will possibly react to the sellers' moves orientated to increase the price of their input. It is important, therefore, to determine the capacity and nature of the possible responses of the buyers and how they may affect the degree of collusion of the sellers.

In the international copper market other factors are also relevant, such as the degree of vertical integration, the dependence

on technology, financial requirements and skilled workers of the exporting nations from the net importing countries, the relations between the host governments and private companies.

### 8.3.1 Sellers' concentration

The degree of concentration of production reflects the capacity that the sellers have to influence the price in their relevant market and it is also an indication of the degree of inter-dependence of the sellers' decisions. The position of the suppliers in the world and market economies are also important, but they can not be considered independent from the fact that the world copper industry operates on the basis of three almost self sufficient markets; the possibility of coordination of the producers' decisions in the international market depends upon the nature of the relations between these markets.

The net exporters produce about 55% of the world output; most of the balance is controlled by the US and the centrally planned economies whose production basically supply their internal demand.

In the market economies the net exporters control 73% of the production and about 90% of the output which supply the international market; except the US, the net importers have not reserves large enough to support expansions of production.

In the international copper market the 4, 10 and 20 largest companies control 51%, 72% and 81% of the production of their relevant market, respectively (see Tables 5.19 and 5.20). The remaining 19% is produced by a relatively large number of companies, some of which supply the domestic demand of some net importing countries.

This level of concentration suggests that the decisions of the leading suppliers are inter-dependent and the market still maintains

the structure of an oligopoly. However, as already discussed, the policies of administration of the mineral concessions of the governments of the developing nations exporting copper may cause an important drop of these levels of concentration.

Concentration by countries is relatively high, ten nations control about 93% of the net exports (see Table 5.10). This situation suggests that the policies of the governments affecting the competitive position of their industry are also inter-dependent so each of them has to take into account the policies and/or the possible reactions of the other to formulate and/or modify its policies.

However, there is neither a dominant country, nor a dominant company, which can impose discipline on the others. This implies that if there is not a collusive agreement in operation, it may take a relatively long period to adjust their policies to the changes in the market conditions, since negotiations will tend to be necessary. Three other facts reinforce this behaviour, the poor tradition of cooperation of the leading suppliers, the fact that most of them are relatively new producers, and that the exporters do not set the price of their output.

Moreover, there are important differences among the copper exporting nations in the level of economic and social development and the extent to which their exports depend on copper.

The countries whose copper exports represents more than 50% of their total exports only control 55% of the market. The developing nations' exports of copper are about 75% of the net copper exports of the market economies. The market share of the latter is not large enough to implement concerted action by themselves, since an important part of the remaining 25% is also controlled by large producers.

This does not necessarily imply that the developing nations exporting copper can not succeed if they adopt concerted action as strategy. None of the collusive agreements controlled the total international copper market; in all of them the outsiders had an important role. The existence of powerful outsiders may impose restrictions on the policies of the colluded producers, but it does not necessarily rule out the possibilities of operation of an understanding. This rather depends on the nature of the relations between the members of an agreement and the outsiders.

The situation of an outsider is relatively comfortable, since it may benefit from the understanding without sharing the responsibilities of the members of the agreement, but this can be possible only if the outsiders control a small share of the market. If the outsiders are large relative to the size of the market, its market decisions will affect the colluded producers which will react and probably retaliate against unjustified aggressive moves.

As discussed in Chapter 3, the members of an understanding have two possible courses of action to face an uncooperative outsider which controls an important market share: (a) to negotiate either with the outsider, with the government where the outsider operates, or with both of them; (b) to retaliate either before or during, or after, the negotiations, depending on the strategy of the colluded producers and the evolution of the negotiations. The definite outcome is unpredictable; it can only be said that the parties have motivations to reach an agreement to avoid intense competition which implies lower prices, reduces the aggregate profits of the industry and create greater uncertainty situations which affect all the participants in the market, the outsiders included.

In an eventual collusive agreement of the developing countries

exporting copper, the most relevant outsider is Canada. It is unlikely that this country will ever become an active member of an understanding; copper represents an insignificant part of its exports and part of its production is associated with other minerals. However, this is not to say that the government can ignore the policies of the other copper exporting countries, since the objectives and policies on copper depend upon the measures that the other governments are implementing. After the nationalisations there is no reason why the Canadian producers will operate against an international copper scheme supported by other suppliers of the international market; except in 1930 they have always behaved as friendly outsiders. Even in the unsuccessful experience of 1974-76, the Canadians were cooperating before the agreement broke down. Moreover, some of the companies operating in Canada are trying to invest in developing nations to improve their competitive position. But more important, the uncoordinated decisions, intense competition, oligopolistic uncertainty and even distrust, have also affected the Canadian copper suppliers.

Another important outsider of a collusive agreement would be the marginal fringe constituted by secondary production of old scrap. Production of new scrap entirely depends on current consumption and is not an additional source of supply. Secondary copper meets about 17% of the aggregate demand. Historically, except in the very particular conditions prevailing in the immediate post First World War and during the crisis of 1930, it has not played a determinant role in any of the collusive agreements pursuing price stabilization (1).

(1) In the 1930s the cost of scrap recovery, essentially labour, experienced a drastic reduction due to the high rate of unemployment, the absence of legislation on minimum wages and salaries, and the non-existence of Social Security. This situation permitted the cost of scrap collection to fall faster than the cost of mining, determining a more rapid contraction of primary than secondary production. In the worst years of the crisis, production from secondary sources was a significant part of the total supply in the US.



In the short term, supply is relatively responsive to price variations, but in the long term, its rate of recovery depends upon the historical rate of consumption; but prices do not affect the rate at which the products containing copper are worn out. High price gives an incentive for the recovery of scrap in less accessible areas and makes available scrap of lower quality, but within certain limits, due to the growing marginal cost of the former and the highest cost of processing of the latter.

Copper recovery is a fairly competitive market, hundreds of dealers participate in this activity in each country, therefore they can not be incorporated in a scheme which intends to regulate the price. Conversely, the dealers do not have financial capacity to operate against the policy of the copper producers.

The behaviour of the US producers would also be important for a collusive agreement operating in the international market since the balance of supply and demand of each market interact into the other. In this context, it is important to note that the situation prevailing in the international market has become more important in the formulation of the policies of the US suppliers for several reasons: this country is a net importer, it has experienced a significant market share loss in world production and consumption; the costs of production are higher than in the international market; the tariff has become unimportant due to reductions agreed in international negotiations and inflation has reduced it in ad-valorem terms; subsidiaries of some of the US producers were nationalised, losing the significant influence they had on the international market.

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In the US the important market share controlled by the largest suppliers at all the process of production permitted them to coordinate their decisions on the basis of a price leadership system

until 1978. The operation of such a mechanism resulted in lower and less frequent price variations than in the international market. Generally, the literature on copper infers that the US producers try to reduce substitution; however, as a long run consideration, the regulation of the rate of entry in the copper industry has also been important. But the producers have had a more permanent inducement to avoid frequent price variations and intense competition during the slump; it would have been difficult to compensate the lower level of profits during the booms due to direct or indirect government intervention; for instance, in 1950-73, the strategic stockpile was a deterrent to price increase; in the 1960s at least once the President of the US induced a price reduction; in 1972-74 the prices of copper were controlled.

In the period of high demand, the US producers' prices were lower than those prevailing in the international market, while in the recession, they were higher. The US consumers did not substitute domestic for imported copper, because the companies could have reduced their shipments to the unloyal customers when the balance between supply and demand tightened, forcing them to buy in the international market at higher prices. The fact that the US primary producers also controlled an important proportion of semi-manufacturing was a factor which reinforced the operation of the system. However, such a policy can operate if the recessions last short periods and/or there is oligopolistic discipline in the international market. When the companies set prices well above those prevailing outside the US during the period of intense competition in the international market (period 1976-77) the US consumers started to abandon their traditional suppliers and copper imports made an important inroad in that country. The US producers not only had to abandon their policy but also the mechanism of coordination they had used for more than 40 years.

There is no reason why the US companies would not co-operate with a policy of concerted action: the energy crisis has affected them with more intensity than the suppliers of the international market, because the deposits in exploitation in the US have lower copper content; the operational costs of the US suppliers are higher than those of at least some of the leading producers of the international market; besides since the anti-pollution legislation started to be implemented, the companies have had to make considerable financial commitments to meet the environmental standards, so they have an important incentive for avoiding intense competition. Moreover, some of the US copper companies have plants in operation in developing countries and others are trying to obtain access to the copper reserves of these nations; therefore there are mechanisms to induce co-operation and/or to retaliate if necessary. However, it is unlikely that the US producers would support a high price policy because they set theirs on the bases of long run considerations and because a policy of high prices may induce intervention of the US government in the industry.

It is important to note however, that historically the coordination of the decisions between the suppliers of the international and the US markets were easier because US companies were leading producers in both markets. After the nationalisations, only one company has such a position. This suggests that coordination may be more difficult.

The centrally planned economies considered as a unit have been net exporters of copper in some years and importers in others, but in either case, the balance of trade with the market economies has been marginal. It is unlikely that this situation will change.

To understand the behaviour of the producers in the international market, another characteristic is relevant, the leading suppliers are divided into two sectors with different characteristics: (a) the state owned companies which have important competitive weaknesses: deficit of skilled workers, lack of direct connections with financial centres, dependence on others' technology, and their sales are almost totally dependent on copper and their production totally linked to the situation prevailing in one country; (b) the private companies which control technology, most of them are connected to important centres of finance and inter-connected to their rivals, operate in different countries and have gradually diversified their operations. They face greater competition for the access to the copper resources; to a large extent most of them depend on the reserves of the developing nations to stay in the market and/or to improve their position.

#### 8.3.2 The homogeneity of the product

Copper is an homogeneous product, but due to the distinct degrees of vertical integration in the primary copper nations, it is traded at different degrees of elaboration: concentrates, blister and refined whose trade practices are different. This situation has important implications for the coordination of the producers' decisions.

(i) The producers of concentrates and blister sell their output on long term contracts in contrast with the vertically integrated producers which sell theirs on an annual basis. The former therefore have a better bargaining position than the latter and, at least as suggested by the 1974 CIPEC experience, their negotiations may take a relatively long period. Although they tend to come to terms (since the lower prices affect both of them), their decisions may be ineffective for the lack of opportunity and delay in which they are adopted.

(ii) The custom-smelters operational characteristics are rather different to those of the primary producers, their profits depend on the service they perform, rather than on the price of copper. An output curtailment of the primary producers, other factors constant, cause an increase of their costs per unit which is not compensated with an increase in revenue.

This characteristic of the custom-smelters has determined important confrontations with the primary producers during periods of demand decline. In the 1930s for instance, the US custom-smelters opted for increasing processing from secondary sources, while the mining companies were implementing output reductions; secondary refined copper represented about 50% of the US supply in the worst years of the crisis. But more relevant may be the experience of 1974, the Japanese custom-smelter re-exported a substantial amount of copper while copper consumption and prices were declining. The latter experience also suggests that the exporting nations may negotiate with the governments of the importing countries and obtain an interruption of such exports, but such agreement may be ineffective, since the custom-smelters control an important proportion of the semi-manufacturing industry so that they can compensate such reduction by increasing exports of wrought copper.

The custom-smelters process more than one-third of the primary output of the market economies, therefore they will continue playing a significant role in any collusive agreement.

More difficult is to determine whether their importance will tend to increase or not. There are factors operating in both directions and none of them seems dominant.

(i) The governments of the copper exporting countries have been stating that they intend to increase the degree of elaboration of

their copper exports to increase value added, foreign exchange revenue and employment. However, their policies have been formulated without coordination.

(ii) In the 1970s was forecast a flow of investment to the exporting countries, due to the higher costs of smelting in the industrialised countries, caused by the anti-pollution legislation and to the fact that the higher prices of energy affected the cost of transport of concentrates which have lower copper content.

(iii) The intense competition among the primary exporting countries have made easier the location of new custom-smelters in under-developed nations which will import the raw material and re-export it after processing to industrialised nations. The amounts of copper involved do not permit a firm conclusion about this rather new development. The persistence of this process will largely depend upon the response of the primary exporting countries.

(iv) The copper mining companies are generally motivated to reduce the capital per unit of output in areas considered unstable. Moreover, in periods of shortages of concentrates, the companies may negotiate relatively favourable charges for processing their copper in the facilities of the custom-smelters.

(v) The custom-smelters have already gained a position in their relevant markets and they will not forego their position despite that adverse factors are affecting their operational costs.

Moreover, the governments of the consuming countries are concerned with the possibilities that companies of their countries improve their position and influence on a market which may affect the competitive position of other industries. If necessary, these governments may grant other concessions to the custom smelters to compensate their competitive disadvantages.

In summary, there are no economic factors clearly operating in favour of a higher degree of vertical integration in the copper exporting nations. The possibilities that these countries can attain their objective are closely related to the possibilities that they can integrate their policies. In other conditions, to persist in such objectives might affect their competitive position in the copper industry.

### 8.3.3 The time horizon for the evaluation of the decisions

The developing countries exporting copper have had a remarkable preference for short rather than long term considerations to make their market decisions due to their balance of payment deficits and foreign exchange shortages. They must use an extremely high rate of discount to evaluate their market decisions.

In such circumstances the possibility of imposing producers' discipline are negligible. However, such a behaviour tends to aggravate their position, especially in the down turn of the cycle. It can be expected however, that a process of learning by doing may induce them to opt for an alternative basis of evaluation of their policies.

### 8.3.4 The level of costs

The differences of cost of production among the large producers have played an important role in all the collusive agreements.

In the second half of the 1970s the cost differences increased among the leading suppliers of the international market. This is explained by two major factors.

(i) On the one side the more unstable political situation in the South African Cone determined an increase of the cost of the expatriate workers on whom both Zaire and Zambia rely to maintain in operation their mines. On the other side, the transport problems caused by



the closure of the Benguela Railways in 1975 and the still inadequate alternative solutions have caused an increase in the cost of the shipments of copper and the imports of physical inputs. It is not possible to predict an improvement of this situation; but it can be said that if the political conditions do not deteriorate there are enormous possibilities to increase productivity.

(ii) In Chile the prohibition of political activities and restrictions to trade unions have determined a reduction of wages and salaries. However, a policy of drastic restrictions of salaries can not be maintained for a long period without endangering the long run competitive position of the industry.

The rate of exchange policy has become an important determinant of the level of costs since inflationary pressures and balance of payment deficits are affecting the major producing areas. The relatively rigid rate of exchange maintained by some of these governments has determined that their costs differences change in relatively short periods.

In previous collusive agreements the rate of exchange had not a relevant role, because the national currencies were devalued according to the rate of increase of the prices and/or because the rates of variation of the prices were much lower than those of the second half of the 1970s.

It is also important to note that the proportion of the cost which involves expenses in foreign revenue is more important in Papua New Guinea, Zaire and Zambia, than in Chile and Peru. This suggests that the first group of countries are more vulnerable to the reductions of prices of copper so that they have a stronger tendency to avoid intense competition in the industry and that the price preferences of the Peruvian and Chileans will tend to be lower in periods of recession.

Competition eliminates the high cost producers in the long run. In the short term the suppliers may adjust their production. About 15% of the primary production outside the US and centrally planned economies is extracted from high cost mines whose output has a considerable low price elasticity because the governments support them in periods of economic distress for employment, regional or other considerations. Therefore the burden of the responsibility must be borne by the large scale of producers if a drastic price drop is to be avoided. Among the large scale suppliers, the highest cost producers do not necessarily reduce their output when prices decline, since such policy may make more unfavourable their bargaining position. This situation may determine that unco-operative behaviour by the lowest cost producers may prolong the period of adjustment, or even lead to a situation in which the sellers lose the capacity to influence the market as occurred after the CIPEC agreement expired in 1976. Moreover, persistent unco-operative behaviour by the low cost producers during the slump may determine that they also lose the possibility of influencing the market during the boom, since the high cost suppliers may be reluctant to co-operate with a policy of price restriction to recover their financial position and to compensate the losses accumulated in the period of low demand and intense competition.

In the copper industry the lowest cost producers have no alternative than co-operation to influence the prices. The alternative behaviour leads to lower prices, but the level at which they are driven down are totally uncontrolled; in the long run the lowest cost producers reduce the possibilities of imposing its strategy.

### 8.3.5 The structure of cost

Copper is a capital intensive activity. In periods of recession the sellers' profits tend to fall rapidly since, as they adjust production, their average costs increase, as overhead costs spread over a reduced number of units. As financial pressures increase, the suppliers have a greater inducement to violate the discipline of the industry.

However, the fact that an intensification of competition tends to aggravate the market imbalance and to make sharper the price decline, is an incentive for the sellers to apply self restraint in their market decisions, particularly because the floor at which the prices may fall (marginal cost) is too low.

The fact that the sellers set the price on the basis of a marginal market determines that negotiations are necessary to set up a policy of price stabilization. There are reasons to expect that the bargaining process will not be short and it is likely that during the negotiations the suppliers do not restrict their sales, since independent cuts improve the bargaining position of the rivals, especially that of the lowest cost producers. Such a behaviour causes a sharp decline in price.

If stabilization is adopted as a course of action, the financial position of the suppliers is affected both by the low level of price at which stabilization start to be implemented and by the increase of the unitary cost caused by the cuts. In these circumstances, an additional adverse change in the market situation may destabilize the agreement.

Another destabilizing force is determined by the fact that the primary exporters only control one of the processes of production, mining. Therefore, since the output curtailment is adopted until

the flows of copper reaching the market are reduced there is a relatively long period. But if the cuts are adopted both on sales and production the time lag can be reduced.

For the success of a collusive agreement in the copper industry it is essential that the decisions are made opportunely. The lack of opportunity only makes more difficult the implementation of the sellers' policies: the buyers postpone acquisitions; the financial pressures on the producers accumulate while distrust among the sellers grow, since it is difficult to control their level of stocks and the risk that the market lose credibility in the suppliers policies increase.

More in general it can be said that a mechanism of coordination of the producers' decisions can not be conceived to undertake stabilization once the level of price is collapsing, but to prevent changes from the level of stabilization chosen.

#### 8.3.6 Capacity of production and collusive agreements

Two aspects are relevant in the relation between collusive agreements and capacity of production: the price policy of the colluded producers and the effect of additional capacity of production on the operation of a producers' agreement.

When the producers' decisions are inter-dependent, the relations between the price policy and the capacity of production are not mechanical. But it can be said that a high price policy incentive investment in exploration (potential competition increase if exploration is undertaken by others than the existing suppliers); it may stimulate new entries into the market, it increases the risk of uncoordinated decisions of investment by the existing producers, including the members of the understanding and if idle capacity is relevant, it may destabilize the agreement. For the investors, the

relevant prices are those prevailing in the market after the completion of a project; these prices depend in turn on the prevailing general market conditions and the possible reaction of the rivals to the additional capacity of production.

In the three most successful collusive agreements implemented in the copper industry (Copper Exporter Association, 1919-1923; the International Copper Cartel, 1935-1939; the experience of 1957-1966), the sellers adopted a conservative price policy. In the two pre-Second World War experiences, the reason was basically the same, high percentage of idle capacity, an important proportion of which was affecting the outsiders of the agreement. In 1957-1966, the reasons were different, to avoid expansion of the marginal producers, to reduce the risk of substitution and over-expansion of capacity of production.

During the nationalisations, the weaknesses of the producers and the high price policy were two of the factors which determined the expansion of marginal suppliers, the entry of new producers, and uncoordinated decisions of investment.

The lessons drawn from these experiences suggest that the price policy of any collusive agreement must be relatively conservative.

The arrival of production from new capacity, either from existing companies or new entrants, affect the degree of collusion since the projects of investment are generally large, relative to the size of the market.

The long period of gestation of a new mine and the important financial commitment of the investment determine that the investors are reluctant to accept restrictions of production, while the rivals are also reluctant to make market concessions.

During all the collusive agreements, important flows of production from new capacity arrived into the market. It was one of the

factors determining the collapse of Copper Exporter Inc. and one of the reasons why the Chilean government did not renew the CIPEC agreement in 1976. In the successful understandings, new capacity reached the stage of production in periods of expansion of demand and the investors accepted to increase production gradually from the new mines (the Northern Rhodesian in the 1930s) or to reduce output from their plants in operation (ASARCO in 1960-1963).

The stability of any eventual collusive agreement will be affected by the arrival of new capacity. The possibility of overcoming the impact will be greater if the suppliers plan their investment at least to avoid the simultaneous arrival of substantial new capacity. But a consistent price policy would be required, otherwise all the efforts invested in planning would be wasted.

#### 8.3.7 Changes in the market conditions

Abrupt adverse changes in the market conditions unfavourably affect the stability of the collusive agreements. On the one side they modify expectations, increase uncertainty, making it difficult to agree on a common course of action. On the other side, they generally affect unevenly the producers and the consuming markets; the suppliers divert their sales from the more to the less depressed countries, causing reactions from the traditional suppliers of these areas, situations which tend to make more difficult the agreement of new policies.

The most typical example was that which preceded the collapse of Copper Exporter Inc. in 1929-1931; in the US the demand for copper fell more abruptly than in Europe, but the suppliers in the international market were being affected by the entry of new producers. For two years the copper companies could not agree on output curtailments compatible with the demand reduction. An agree-

ment could only be reached when the position of all the suppliers had considerably deteriorated.

A more recent example - in 1975 all the producers were implementing output curtailments in the market economies; in 1976 the US companies decided to suspend their cuts, because domestic consumption was increasing abruptly (26% by the end of that year), but they continue supporting prices above their average cost; the suppliers of the international market started to penetrate the US market process which was made easier by the fact that the US suppliers set prices well above those of the international market. One year later the US companies had to abandon such policy and to discontinue the operation of the producers' price system to reduce the market share the imported copper had captured.

All the collusive agreements had to confront abrupt changes in the market conditions. The survival of some was because demand started to recover and because the suppliers had strong incentives to avoid intense competition.

The stability of any eventual collusive agreement will be threatened by such fluctuations. This suggests that the understanding must provide enough flexibility in order that the policies can be adapted to the changes in the market conditions; this is important, since one of the parts may emphasize the formalities and mechanisms of control of the agreement, reducing its capacity of adaptation to the new situations. The possibilities of overcoming the impact of the adverse change in the market conditions will be greater if the understanding is orientated towards long run objectives, rather than to seek short term gains; this necessarily implies the need to reinforce areas of co-operation other than coordination of the market decision; the larger and the more relevant the areas in which the

producers can concert their actions, the greater their interdependence and their incentive to hold together their policies.

#### 8.4 Strategy of the consuming countries and collusive agreements

The buyer market's main characteristic is the high concentration of imports and consumption in few countries, and within each nation few companies control most of the imports. Concentration has been declining, but is still very high. Except the US, all the large importers are almost totally dependent on foreign sources of supply. The buyers' decisions are interdependent and have a considerable influence on the selling market.

The buyers' policies on copper are part of a more general strategy on raw material procurement. Some general formulations have been made and it is likely that these governments will give more emphasis to their policies for four main reasons: (i) they are operating in a more competitive environment; (ii) the suspension of the investment in new mining capacity since 1974 due to the recession which raised cost and lowered income of the industry; (iii) the host governments will improve their bargaining power when economic recovery start; (iv) there is greater political and economic instability in some of the major producing areas.

Although the importing nations use different approaches in their raw material policies they have common general objectives, use similar criteria and their national mining companies have an important role in the implementation of their policies.

According to the formulations, the main objectives of their strategies are to secure the availability of the resource; the diversification of the sources of supply; to improve the utilization of the raw material and to counteract the dependence on few partially unstable sources of supply.



Considering the importing countries as a unit, some of the relevant elements of their strategies are as follows:

- (a) Diversification of the sources of supply.
- (b) To provide incentive for co-operative exploitation of the mineral resources by companies from different countries.
- (c) To stimulate co-operative exploration both in traditional and non-traditional areas.
- (d) To create the condition for the exploitation of the seabed.
- (e) To maintain the control at processing already gained and to preserve the semi-manufacturing industry in the consuming nations.
- (f) To promote the search for substitutes, including the stimulation of recycling and rationalisation of the use of the raw material.
- (g) Additional guarantees to mining companies operating overseas including reinforcement of the systems of insurance and the promise of support if the host governments introduce drastic changes in the contracts of investment and/or threaten them with nationalisation.
- (h) To set up new sources of finance for the development of new mines and support the investment in exploration.
- (i) Formation of mineral stockpiles.

This is not to say that the importing nations have a common strategy on this raw material and that if their importing positions are affected they will react in the same direction. They have divergent interests, the number of agents intervening in the formulation and implementation of their policies is rather large and the effect of price increase affects them unevenly. Moreover, their degree of dependence on raw materials in general and on copper in particular, differs; copper is more strategic in those countries whose exports of electric products are a high percentage of their

total exports. The influence that the importing countries have on the copper industry is also different in terms of the number and importance of the mining companies operating in the copper industry; their access to the copper reserves and the significance of the processing facilities they control.

However, the importing nations have a great deal of experience in dealing with raw materials procurements, they base their decisions on long run objectives and have more flexibility in the operation of their strategies since they control important variables such as the financial resources, the technology and the expertise required at least for some of the developing countries.

The strategies of the consuming countries will not only affect any eventual collusive agreement, but also the structure and behaviour of the producers. This implies that any understanding which does not consider the integration of the policies of the primary exporting countries will fail.

#### 8.5 The strategy of the exporting nations

In 1964-1974, the policies of nationalisation and greater control of the copper resources implemented by Chile, Peru, Zaire and Zambia had a considerable impact on other producing areas. In nations where the copper started to be mined, the governments acquired minority ownership in the companies (Indonesia and Papua New Guinea); smaller copper producers also opted for nationalisation (Brazil, India, Mauritania and Mexico); countries where production was to start also decided majority ownership in the new projects (Iran and Panama) and even in a developed nation, Australia, the government introduced a legislation whereby the foreign companies had to sell to Australian citizens 50% of the shares of their concerns in this country.

When the process was just over, the Chilean government introduced a policy just in the opposite direction to the strategy implemented in the previous ten years. It did not accept agreements on output restrictions, it started to grant mineral concessions to foreign mining companies, and it approved legislation introducing benefits and guarantees to the investors. Other countries followed. In a relatively short period (1976-1978) twelve mineral concessions on new deposits were granted to private companies, most of which are new entrants or marginal producers in the international market. Assuming that all those deposits are economically feasible, the estimated initial annual capacity varies between 0.9 and 1.2 million tons, that is between 20 and 25 per cent of the 1976 production of the market economies outside the US.

In 1964-1974, the policies of the governments of Chile, Peru, Zaire and Zambia experienced at least two changes in each country, but without affecting the overall strategy. The policies adopted had differences but they coincided in the following objectives: integration of the industry to their economies; to maximize the foreign income obtained from the industry; to increase the value added in the primary exporting nations; and to stabilize the price of copper.

They did not integrate their policies. By the end of the period, there were several areas in which co-operation was necessary, including the possibility of incorporating other copper exporting nations. The following are some of the areas where co-operation was possible:

- (1) Stabilization of the prices and income of the industry.
- (2) Reduction of the impact of seabed mining on shore copper mining.
- (3) Vertical integration in the primary producing areas.

- (4) Development of the semi-manufacturing industry on an export basis in the primary producing nations.
- (5) Coordination of the decisions of investment, at least to avoid significant over-capacity of production or important deficits.
- (6) Benefit granted to foreign companies investing in copper mining.
- (7) Research and development to improve their competitive position. Including joint ventures and operation of engineering companies which give service to the copper companies.
- (8) Development of human aptitudes and technical skills in areas of common interest.
- (9) Joint marketing ventures including exchange of information and forecasting.

Most of these areas of co-operation imply objectives which are either difficult or simply impossible to attain through independent policies.

The new policies considerably limit the possibilities of co-operation among the exporting countries.

If the policies continue being implemented on the same basis as in 1976-1978, the structure of the copper industry will experience a substantial change in the international market: the level of concentration of production by companies will fall; the market share controlled by some of the leading producers, the state owned companies, will drastically decline. Limitation of access to the copper resources, being one of the most important barriers to entry, was considerably reduced.

The copper industry will become an oligopoly in process of disintegration. Competition may become relatively intense if demand can not absorb additional supply, either because of over-capacity of production, or because of a reduction of the rate of growth in the market economies.

A second implication is that the strategy of the importing nations will operate without any effective counter-balancing power. As long as there is no threat of disruption of production in one of the major producing areas, none of the exporting nations in particular is essential for the strategy of the importing countries; none of them have either power enough to impose its strategy to the consuming countries. The exporting nations only can improve their bargaining position by integrating their policies.

In 1964-1974, the exporting countries did not integrate their policies and the primary exporting nations considered as a group experienced a reduction in the degree of vertical integration; investments in smelting were made in two totally dependent countries on copper imports. In 1973-1976, continuous casting was adopted by the importing countries and decisions of investment in custom smelters were made in developing countries. The lack of collusion in the selling market and the atomistic policies of the primary exporting nations will tend to accelerate the process of vertical disintegration on the primary producer areas.

The previous analysis is based on the assumption that the policies of the exporting countries will not be adjusted; there is no indication that modifications will be introduced; the strategy has recently been adopted and the compromises already made constitute an important restriction for any change. Moreover, the economic policies of one of the major producing areas is based on liberal conceptions and the attraction of foreign capital.

However, several reasons suggest that there will be a new change of policies.

(a) The strategy adopted ignores the interdependence of the decisions of the companies and the governments. The possibility of expanding

production on the basis of concessions to private mining companies are limited: firstly by the reaction of the other exporting nations which in this case, counteracted the move of the Chilean government. The decisions of the governments affecting other competitive positions are interdependent due to the high concentration of the net exports in few countries. Secondly, it is not in the interest either of the private companies, nor of the importing countries, to concentrate investment in one or a few producing areas.

(b) When the economic cycle reverses the bargaining power will revert to the governments of the exporting countries and the intensification of the competition for copper resources will become more evident. Historically most of the contracts of investments on copper have been re-negotiated in developing countries. This probably will not be an exception, since the concessions made by the governments seem too generous to the companies.

(c) The persistence of the inflationary pressures in the industrialised countries; the price increases of oil and the relatively low level of prices of copper since 1975 have been a permanent pressure to adopt a type of action to stabilize the prices of copper.

A new change of strategy may be adopted by the exporting countries. It is not possible to predict the direction of such a change, but it can be said that the possibilities of an agreement in the selling market will again be affected by the negotiations between the companies and the host governments.

Appendix 1Company Inter-relations

AMAX: It has 20 per cent interest in Copper Range, a small but vertically integrated US copper producer. It has also a joint venture with Anaconda in Anamax Mining Co. where each company controls 50%; the output of Anamax is treated by AMAX, Anaconda, Inspiration and ASARCO. Anamax in turn has reached an agreement with ASARCO to develop the Eisenhower mine which was to begin operations in 1978. AMAX has no majority owned copper mine companies, but it participates with Newmont in O'Okiep Copper Co. (south Africa), and Tsumeb (South West Africa) and with Anglo American Corporation in Botswana Selection Trust, Tsumeb and the Roan Consolidated Mines Ltd. the latter is 51% owned by the Zambian government through Mindeco. AMAX also has 86.5% interest in Ponce Mining an undeveloped deposit, in Puerto Rico where its other associate is Kennecott.

Anaconda: has a joint venture with AMAX in Anamax and through Anamax is also associated with ASARCO in the Eisenhower mine. Anaconda owns 27% of Inspiration where is associated with Hudson Bay, owned by Anglo American. Except for its wholly owned Anaconda Canada Ltd. has become a minority partner in all its ventures outside the US. In Compania Minera Cananea is associated with the Mexican government and in Cobre de Sonora with Phelps Dodge and the Anglo-American Group.

Anaconda was also providing technical assistance in the development of Sar Sheshme Copper Mining Co. which is owned by the Iranian Government and was to be one of the important new mining developments 130,000 tons of refined copper.

Anglo American Corporation: is one of the companies with the largest number of ownership inter-relations in the copper industry.

It has interests in copper companies in four countries (the Societe Minier de Mauritania was nationalized in 1975) but it exercises majority control in one of them. It holds 54% of the shares of Hudson Bay Mining Co., in Canada, which control 18.6% of Inspiration Consolidated where Anaconda also has 27% interests. Hudson also holds 20.6% of Whitehorse Copper Mines and 33.6% of Lytton Minerals Ltd. which in turn owns 48% of Compania Cuprifera La Verde in Mexico;

the remaining shares of Cuprifera are held by the Mexican government.

Anglo American controls 30% of the Botswana Concession where its other associates are Amax and the government of Botswana.

In Zambia holds 49% of Nchanga Consolidated Copper Mines and 12.25% in Roan Consolidated Mines. Both companies are majority owned by the Zambian government.

In the Societe Miniere de Tenke-Fungurume Anglo American holds 28% of the shares. The other associates are a subsidiary of Standard Oil of Indiana; Mitsui; the Bureau de Recherche Geologiques et Minieres; Omindes a company controlled by the Banque de Paris et Pay Bas, the Zairian government and others.

ASARCO: is not only an important producer in the US but also outside this country. In the US it treats the mine production of its own mines, Anamax, Cyprus and Duval as well as the output of its Peruvian subsidiaries and concentrates of some Philippines producers.

Outside the US it has participation in copper mines in four countries. In Peru, Northern Peru is a wholly owned subsidiary and Southern Peru Co. the largest producer of that country where Asarco controls 51.5% of the shares and is associated with Cerro Co. (22.25%), Phelps Dodge (16%) and Newmont (10.25%). In Australia controls 49% of the largest copper producer Mount Isa which is a vertically integrated company. In Canada leases the Granduc Mine from Newmont. In Mexico is associated with the government in Industrial Minera de Mexico.

It has reached an agreement with a group of Japanese firms to study the possibility of development of the Frieda River deposit in Papua New Guinea. The consortia includes Sumitomo Metal Mining, Dowa Mining, Sumitomo Kaisha and Marubeni.

Falcon Bridge Nickel Mines: owns the Falcon Bridge copper mines in Canada and in Norway a smelter-refinery, the Falcon Bridge Nikkelwerk AS which works in toll basis. Until 1975, it owned the Kilembe Copper Cobalt Ltd. but Falcon Bridge sold its interest to the government of Uganda, seven years before the economic depletion of the mine. It has a concession from the Zairian government to explore the Piveto territory in Shaba.

International Nickel Company: Its copper production is a by-product of its 16 nickel mines in Canada. It has no important relations with other copper companies outside Canada.



Japanese producers: have no important direct investment in other countries, but it is likely that this situation will change in the future due to the geographical extensive exploration activities they have been developing. The most important copper mine controlled by Japanese companies is SODIMIZA, Societe de Development Industriel et Miniere du Zaire, which was 80% controlled by the multigroup Nippon Mining Co. Ltd. and 20% by the Zairian government; but in 1975 SODIMIZA became 85% owned by CODEMIZA where Mitsubishi and Dowa also have an interest. Mitsui has an interest in the Societe Miniere de Tenke Fungurume where its other associates are the Anglo-American Amoco, a subsidiary of Standard Oil of Indiana; the Bureau de Recherches Geologiques et Miniere and others. Investment on this deposit has been postponed after expending 200 million dollars, as main reason was given the low prices of copper.

The Japanese producers also control a small mine in Bolivia; in Peru, Furukawa Electric Co. and Mitsubishi, Nippon and Sumitomo own a copper deposit which may be developed. In Venezuela Dowa and Nisho Iwai signed a contract with Corporation Andes to develop a lead, copper, zinc deposit at Bailadores in Merida Province. In Panama, the most important Japanese copper companies<sup>(1)</sup> signed a four years agreement with the Panamanian government to explore an extensive area. In Guatemala, Sumitomo is participating in the exploration of the Oxo deposit. In Papua New Guinea Dowa, Sumitomo and Marubeni as well as ASARCO are investigating the Frieda River deposit. In Malaysia almost all the Japanese processing companies are participating in the recently developed deposit at Mamut. In Mamut Development Co. the main shareholder is Mitsubishi but Nippon Mining, Sumitomo, Mitsui, Dowa and Furukawa are also involved.

Kennecott: is the leading copper producer in the US but it has no important interests in copper outside that country. It has made efforts to develop copper deposits in Puerto Rico where AMAX has an important interest and in Papua New Guinea; in the latter it failed in achieving an agreement with the government and had to withdraw. The Haitian government recently granted exploration and exploitation rights in a large area of this country.

(1) Mitsui Mining and Smelting, Dowa Mining, Mitsubishi Mining Co. And Nittetsu Mining.

Newmont Copper Mines: controls copper production in 4 countries. In the US it has its wholly owned subsidiary Magma Copper Co. a vertically integrated producer.

In South Africa Newmont has majority control of O'Okiep Copper Co. where Amax also has a 17% interest; it has minority interest, 28.6% in Palabora Mining Co. where it is associated with RTZ. In Canada it has interests in three companies: Granduc is 100% owned by Newmont but it has leased it to ASARCO, it also owns 39.7% of Sherrit Gordon Mines Ltd. whose output is treated and sold by Noranda; 23.1% of Bethlehem Copper Co. which has recently tried to buy, but according to press releases the price asked for the shares resulted uneconomic at a copper price lower than 85 cents per pound.

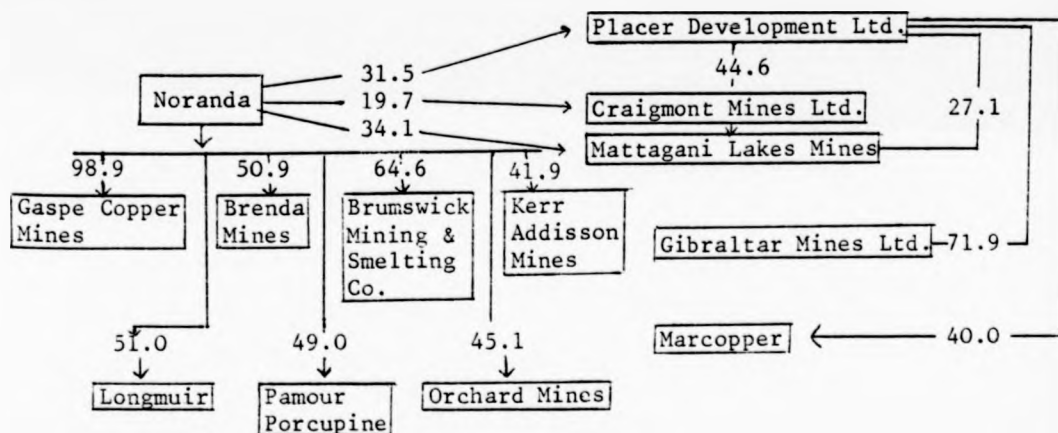
Finally, in South West Africa it owns 29.6% of the Tsumeb Corporation Ltd. where its other associates are Amax and Selection Trust, a subsidiary of the Anglo American Corporation.

Noranda and Placer Development Ltd.: Noranda holds interests in a large number of Canadian Copper Mines, some of them are relatively small but their aggregate production is relatively high. Part of the three Noranda's Division (Geco, Bell and Horne mines) control 7 companies and has important interests in another three.

In Mattagami Lake Mine, Noranda is associated with McIntyre Mines and Canex Placer Ltd. McIntyre sold all its other copper interests to Noranda. Canex Placer Ltd. holds the Canadian interests of Placer Development Ltd., the inter-relations among these two companies are defined in Figure A - 1.

Figure A - 1

Ownership inter-relations between Noranda and Placer Development Ltd.



Noranda treats and acts as sales agent of at least 7 companies whose aggregate production represented 14.4% of the Canadian output<sup>(1)</sup>. It treats but it does not act as sales agent the production of Hudson Bay, controlled by the Anglo American and of the Ecstall Mining, controlled by Texas Gulf which may become an important copper producer.

Phelps Dodge: has always been among the four largest US copper producers, but it has never had important interests in copper mining abroad. It participates in Southern Peru, associated with ASARCO, Cerro Co. and Newmont. It has also interests in Cobre Sonora, Mexico where it is associated with Anaconda and Anglo American Co. It is also participating in the development of the Black Mountain deposit in South Africa where it controls 49% of the shares and Gold Fields 51%. In South Africa Phelps Dodge made three copper-lead-zinc discoveries in Aggeneys; the study of the economic feasibility of the three of them was being carried out in 1978.

Rio Tinto Zinc (RTZ): the most important copper mine controlled by RTZ is the Bougainville Copper Ltd. in Papua New Guinea; it holds 53.6% of the shares through its wholly owned subsidiary Conzinc Rio Tinto of Australia. In Canada the Lornex Copper Co. is controlled through the Rio Tinto Algen which is 51.28% owned by RTZ. In South Africa, it is associated with Newmont in Palabora Mining Col where it holds 39.0% of the shares and manages the company. In Spain it has Rio Tinto Patino through Union the Explosives Rio Tinto and RTZ Investment; another partner in Rio Tinto Patino is Patino Mining Corporation, 40%.

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