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THE METAL EXCHANGES AND THEIR INCIDENCE IN THE DEVELOPMENT OF MINING IN LATIN AMERICA AND THE CARIBBEAN *

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A. BACKGROUND OF THE FUTURES MARKETS

Present day commodity markets have a long history; although modern exchanges are mainly organized futures markets, their origin goes back to the beginning of commodity trade. As commercial requirements became more demanding, markets developed simpler procedures, taking into account the growing number of participants and their geographic dispersion.

The futures markets that we know today date back about 100 years; however, many of them retain some of the forms of those that preceded them.

The most elementary form of commodity market is barter, in which there are no monetary transactions and the products are exchanged directly at the same moment.

After the appearance of money, cash markets arose, their characteristic being the simultaneous exchange of goods for the means of payment utilized. Despite the dramatic change represented by the introduction of money, these markets still required the physical presence of the products that were sold in them.

The next step was the appearance of "spot" markets in which the physical presence of the commodities is not necessary, a display of representative samples being sufficient. The transactions are carried out through titles, or rights, over the products exhibited, and the commodities are physically delivered after the respective payment has been made. The interesting feature of this change is that it constitutes a first step towards standardization of the products transacted in the market.

As time went by and trade was geographically extended, increasing the distance between places of production and consumption, it became harder to have the products physically present in the market and therefore it was not possible to maintain the simultaneity of the sale operation and the physical delivery.

This problem was overcome by the appearance of "forward markets" in which transactions are carried out through contracts for a specific product, which stipulate its delivery at a

pre-determined future date, the payment coinciding with the delivery of the product. The fundamental factor that made possible this market evolution was the greater fluidity of communications, which made it feasible to have more information concerning the availability of the products in time and space.

The forward markets are a most important step in commodity-market development. They allow growth of individual markets, thanks to the increase in the number of participants. The use of standardized contracts and the possibility of deferred delivery are permitted producers and consumers located far from the market to have access to it. At the same time, the increase in the number of transactions meant that markets represented better supply and demand conditions for the different commodities.

However, the most important change made possible by the forward markets was the utilization of the market to cover risks of price variation during the various stages of the productive process. The feature relating to purchases and sales at future dates allowed the producer to sell his production knowing the price and the buyer in advance.

Nevertheless, the markets still maintained, under the new system, their essential characteristics of operating exclusively through physical transactions. Eventually this began to limit market growth, since it required coincidence of buyers and sellers needs, in time and in space. As a result, the classic problem of liquidity arose in the commodity markets, restricting the ability of the buyers and sellers to find a counterpart in order to satisfy their trade requirements.

The solution to this problem was the evolution of the forward markets toward the "futures markets", a transition implying a major separation between the physical market and the exchanges. The most important difference is that the transactions no longer are made for buying or selling a specific product but rather "futures contracts" are transacted.

The futures contract is a standardized agreement for a specific product, of a predetermined quality or grade which stipulates a delivery date and place. The contract is subject to rules which regulate delivery of the product.

The use of standardized contracts not only facilitated those transactions that had the final goal of purchase or sale of a physical product; it permitted in addition transactions where the final intention is not to receive or deliver physical products but rather to cancel the original contract through another of the opposite sign. This development broadened the possibilities of effecting market "hedging", since it made possible advance price fixing without the need for the product to move physically through the market.

However, although the futures markets increased possibilities for price-risk hedging, through disconnection from physical transactions, it was necessary for speculators to enter into market participation in order to achieve necessary liquidity.

Even though the number of participants linked to the physical market for a product may be very large, there is little probability that it will be large enough to provide, alone and continuously, the liquidity required by the futures markets.

The development and functioning of futures markets is intimately linked with speculation and, by definition, the speculator is an individual who participates in a market with an aim different from just hedging. The objective of the speculator is to take a purchase position on future contracts (long) or a sales position (short), while trying to predict price movements that will produce a profit. A special type of speculator is the investor who is looking for the appreciation of futures contracts, or of physical inventories, of a product in the long run.

To the extent that speculators are not particularly interested in the physical market, their participation diversifies a market's supply and demand, giving it greater liquidity. Its essential role is to provide the necessary liquidity so that participants linked with the physical market --producers, processors and traders-- transfer their risks through price coverage.

At present, the main roles of the futures markets are:

1. Formation or "discovery" of a product's price, which includes centralizing all the market information that is relevant for fulfilling this function.
2. Provision of a medium for transfer of risks among different market participants.
3. Facilitation of financing for physical inventories.
4. Provision of a medium for speculation.
5. Provision of a reference price for trading a product.
6. Constitution of a source of supply or destination for the physical delivery of a product.

B. RECENT EVOLUTION OF FUTURES MARKETS

The gradual evolution of futures markets described in the preceding section underwent significant acceleration during the past two decades. In fact, starting at the beginning of the 1970s, futures markets experienced a dramatic change resulting from profound alterations of the world economy.

The clearest evidence of this change is the growth of the volume of transactions in those markets. In the case of futures

markets in the United States, the country that has the largest number of futures contracts, the total volume of transactions rose from 3.9 million contracts in 1960 to 13.6 million in 1970 and 92.1 million in 1980. This growth is impressive, particularly since it took almost 100 years to reach the 1960 volume, and this, in turn, increased almost 25 times in the lapse of only 20 years. Between 1980 and 1987 the volume more than doubled, reaching the figure of 213.5 million contracts (Kaufman, 1986).

The causes of the futures markets growth in the last two decades are of diverse nature and their effects on the markets are of varying magnitude.

At a more general level, the growth of the world economy and the greater integration of international markets have had a vegetative impact on the growth of futures markets. Another influence on growth has been the better understanding concerning the functioning of the markets, which has led to their greater acceptance and utilization.

The specific causes of growth noted above are related to the structural transformations of the world economy, starting in 1971, among which the most important are the following:

a) The elimination of a gold standard between 1971 and 1973 meant the liberalization of the gold market and its increasing use as a means of protection against inflation. The result was an increase in speculative activity in the metals-markets futures.

b) The abandonment of fixed exchange rates in 1973 introduced a new element of instability and risk in international trade and therefore created new requirements for hedging and new opportunities for speculation in the futures markets.

c) The increase and the greater volatility of oil prices as a result of the "petroleum shocks" resulted in an increase in world inflation, greater economic instability and an increase in the volatility of raw material prices. This, likewise, meant greater activity in futures markets (Kuchiki, 1989).

The combination of factors mentioned meant that the different economic agents faced a much greater degree of risk in their operations. In addition to the traditional price risk --in the strict sense--, there were uncertainties associated with fluctuating exchange and interest rates and greater inflationary expectations. The higher degree of instability motivated the search for investments that would be more profitable than the traditional ones. The futures contracts were an attractive alternative due to their high leverage.

Another decisive factor was the greater monetary liquidity, a product of the increase in petroleum prices and the recycling of

oil-producing countries' surpluses in the financial system of the developed countries.

Both factors determined new speculative coverage and investment needs, which gave rise to the establishment of new futures contracts. The new contracts were preferentially "financial products", such as United States Treasury bonds and certificates, stocks and currencies. Financial futures by now have come to constitute the major part of total futures transactions, representing 63% of that total in United States markets in 1987, whereas commodity futures accounted for the remaining 37%.

Over the course of the last 10 years the growth of futures markets has in addition been facilitated by technological changes which have made available more information with ever-increasing rapidity. This communications revolution has likewise permitted connections between markets that operate in different time zones, giving rise to round-the-clock trading, which also contributes to increasing operations. Finally, the availability of information has permitted stockbrokers to manage enormous investment portfolios simultaneously. The centralization of these funds and their administration through computerized programmes has had an impact on the futures markets, increasing their liquidity as well as the volatility of prices. Their institutional expression is found in the commodity funds, which invest the money of individual speculators in commodity markets futures. Each investor has a quota or share in the fund, which gives him ownership over a fraction of the portfolio maintained by the commodity fund.

Futures markets have undergone quite a radical transformation over the past 20 years. The most important aspect has been the growing importance of exchanges in the determination of raw materials prices. In addition, commodity markets have been integrated globally and are influenced in greater measure by the behaviour of financial markets.

C. THE METALS EXCHANGES

The development of the metals exchanges has been similar to that of the rest of the futures markets, but with characteristics of its own that result from conditions in the international metals and minerals trade. At present, with the exception of precious metals, there are two main markets where non-ferrous metals futures are traded: the London Metal Exchange (LME) and the New York Commodity Exchange (COMEX). There are other metals markets, although of much less importance, such as the Mid-America Commodity Exchange and the tin markets in Malaysia: the Kuala Lumpur Commodity Exchange (KLCE) and the Kuala Lumpur Tin Market (KLTM).

Of the markets mentioned, only the LME and the COMEX are really international futures markets and their prices serve as reference for a large part of the physical non-ferrous metal trade. In this section the development and the characteristics of the LME and the COMEX will be analysed. The situation of the other exchanges will be discussed in chapter II, within the analysis that will be made of the characteristics of individual metals markets.

1. The London Metal Exchange

The LME is the oldest and the most important of the metals markets. At present, futures contracts are transacted there for aluminum, copper, tin, nickel, zinc, lead and silver. Starting in 1987, options for the same metals started to be transacted officially, with the exception of tin (see description of present LME contracts in annex I.1).

a) Historical evolution

Origins

The origins of the LME go back to the middle of the past century. At that time England was the main world producer of copper and tin, in addition to being the principal consumer country for metals. The increase in demand resulting from the industrial revolution eventually meant that it was necessary to import metals from South America, Africa and the Far East.

At that time, the characteristics of maritime transport implied great risks, owing to uncertainty as to dates of arrival of the cargo, or whether or not it would even arrive at its destination. This fact led London metals traders to establish a future arrivals market for metals. It functioned as a forward market in which merchants transacted specific shipments, the price of which depended on probable dates of arrival and conditions of demand expected for that time. The merchants met in the fashionable cafés that surrounded the Royal Exchange and, in time, their favourite meeting place was the Jerusalem Coffee House. They stood around a circle drawn on the ground and announced the prices in a loud voice. The transactions took place between principals; that is to say, the purchase-sale contracts were made directly between two traders, without the existence of any intermediate entity (clearing house) to guarantee fulfilment of contracts.

The "principals market" system, which existed without important changes up to 1987, was founded on ethics through which compliance with the rules of operation of the exchange guaranteed collective security. The main advantages of the system are the flexibility that permits agreements between brokers and their clients, the lower cost of operation since no margin deposits are

required, and the privacy that users enjoy, due to the fact that there are no information requisites applied to the operations (Gibson-Jarvie, 1976).

The contracts

In 1876 the London Metal Exchange Company Ltd., was formally constituted, with its own offices. The establishment of telephone and telegraph communications improved the flow of market information and toward 1880, the first contracts were standardized (although these were not of an official nature). The first "grades", or basic qualities, for metals were the Chile Bars and the Straits Tin. The rest of the metals were subject to negotiation case by case.

In spite of this development, the typical problems of a forward market continued. In reality, the number of transactions was limited, due to the need to have coincidence between the date of arrival of a shipment and the date when the consumer would need the commodity. All future transactions were effected on the basis of warrants or certificates of possession of the physical material. Transactions were liquidated against delivery or reception of the warrants.

In 1883 the first standard LME contract was introduced. This contract was a purchase-sale contract for a product of specified quality for delivery within a determined period. The first standard LME contract was one for copper called Chile Bars. At this time Chile was the first world copper producer and the contract stipulated delivery of the material three months after the date of the transaction, which was exactly the time it took for the voyage to England from Chilean ports.

It may be noted that the original contract term of three months has been maintained in the LME until the present time for all metals transacted there. In fact, although recently the contracts term has been extended up to 15 months, most activity in futures continues on the basis of three months. This curious note on the origin of the three months contract tends to highlight how futures markets developed on the basis of physical markets.

With the introduction of the standard contract for copper and later for tin, the development of the LME as a futures market got under way. However, the LME has been quite a sui generis futures market. It differs from other futures markets mainly in that it maintained, for a long time, its system of transactions between principals and its preference for serving the coverage needs of the metals industries.

Over its long history, the LME has abandoned transactions of some metals, such as iron, and has introduced others, thus arriving

at the seven metals currently transacted. The last to be incorporated were aluminum in 1978 and nickel in 1979. The introduction of these contracts was determined by the evolution of the metals industries themselves, where the large producers gradually lost the ability to regulate the market through producers prices, giving rise to a situation where price determination on the exchanges became preferable.

Changes have taken place not only with regard to the metals transacted but also in the quality specifications for each one of the metals. In fact, the official contracts of the LME have frequently been modified in order to take into account technological changes occurring in the metals industries. The most recent tendency has been that LME contracts should reflect as faithfully as possible the quality specifications of those products that make up the bulk of international trade of a particular metal. However, this process has not been exempt from tensions and differences in criteria between the LME and the industries' representatives, due to the different interests of each party.

Growing internationalization

Another aspect of the LME's evolution refers to its growing internationalization. On the one hand, the composition of its membership has ceased to be mainly relatively small, independent English or European companies, specialized in the metals trade; these have been replaced by subsidiaries of large transnational trading firms and North American Commission houses.

Another aspect of the internationalization of the LME is that the geographical coverage of its warehouses has been considerably diversified over recent years. The reason for this has been the necessity of users to have points of delivery, or reception of physical material, close to the most-important consuming centres and to increase the representativity of the LME in conditions of physical markets.

In 1962 the first warehouse authorized outside the United Kingdom was established in Rotterdam and later several others were set up in various European ports. In the past two years the LME has intensified its internationalization efforts establishing its first port outside Europe. In January of 1988, a LME port was opened in Singapore and, in July of 1989, aluminum warehouses in Japan. At present the LME is considering the possibility of establishing warehouses in the United States for some of the metals it transacts.

Another way of broadening international coverage has been to change the transaction currency of the LME contract from pounds sterling to dollars for all metals except copper and lead.

Consequences of the tin crisis

Over the course of its history, the LME has had problems of varying magnitude which have affected its operations. Some of these have been caused by external factors, such as the suspension of operations during the two world wars. Others have been affected by both internal and external factors and, among them, are found numerous attempts to manipulate prices of various metals. These attempts, some of which were successful for those initiating them, and others ending in great failures, were effected mainly by groups of producers, traders and/or speculators. Among manipulatory incidents affecting the LME, the one that had the deepest effects for the functioning of the exchange was the tin market crisis, which broke out in October 1985. It submerged the LME in a long period of uncertainty concerning its future, finally giving way in 1987 to the most important restructuring in its entire history (Anderson and Gilbert, 1986).

This crisis was caused by the collapse of the tin price-support system maintained by the International Tin Council. This organization representing 21 countries producing and consuming tin had for several years been purchasing tin futures on the LME and in Malaysian markets, as part of its tin price stabilization scheme. During the years prior to the crisis the Council had been increasing significantly its tin purchases, as a way of supporting an artificially high price in the face of a constant increase in production of the metal and a stagnation in demand. The real situation of the tin market eventually made itself felt in the LME and caused the price decline. The Council, however, had already exhausted its own financial resources and its sources of credit --among them the LME brokers-- and therefore could not continue to support the price. Faced with the imminent collapse of the price of tin, the LME suspended transactions of the metal.

However, the problem was only beginning. The purchase positions of the Council in the LME showed a loss close to 900 million pounds sterling, an amount which had been financed by the brokers acting for the account of the Council. The liquidation of the Council's purchases implied that this organization would have to obtain the funds necessary to pay the enormous price difference. However, the Council did not have the funds and the majority of the member countries were not disposed to pay. This meant bankruptcy for a large number of brokers and eventually the bankruptcy of the exchange itself.

The crisis revealed in all its magnitude one of the greatest weaknesses of the system of operation between principals of the LME. In fact the magnitude reached by the problems before the crisis occurred would only have been possible for this particular form of organization of the Exchange.

Under the system of principals, the contracts between brokers of the exchange had no guarantee of fulfilment other than mutual confidence. The same principle was extended to the contracts between brokers and their clients, although in some cases the brokers required that their clients deposit guarantees to cover part of positions considered to be very large or risky, the amount of the deposit being at the discretion of each broker.

This system contrasted with the norm for the rest of the futures markets, where a central body acted as a clearing house for the market, guaranteeing fulfilment of obligations. For this purpose, the clearing house requires the deposit of a proportion of the initial value of the contract (initial margin or original margin) and, in addition, effects a daily balance of the positions of each broker, requiring the payment, or depositing the value of the price differences (variation margin) that show the consolidated positions at the end of the day. This system is called "cash-cleared market".

Since this system did not exist in the LME, the brokers accumulated large positions for account of the Tin Council without requiring guarantees, based on the confidence inspired by a client backed by the member countries. This situation was aggravated by the lack of an information system that would have facilitated knowing precisely the size of the Council's position.

The lessons of the tin crisis were very clear for the LME. After the suspension of the tin contract, confidence of the users of the exchange declined and this brought about a fall in the volume of transactions for all metals (see table I.1). Some brokers with less financial support went bankrupt and others suffered large losses. Litigation still continues between brokers and the Council in an effort to recover part of the losses. The LME had no other option than to submit to a total reorganization of its structure in order to solve the crisis and re-establish confidence in it.

b) Present organization of the London Metal Exchange

Transaction system

In May of 1987 the LME replaced the old system of transactions between principals with one that incorporates a clearing house. In addition to being a result of the tin crisis, this change was determined by the decision of the Government of the United Kingdom to regulate financial and futures markets in the city of London. The new regulations were expressed in the Financial Services Act of 1986 and in the creation of the Securities and Investment Board (SIB) in 1987.

Under the new system, an independent organ that was already serving other exchanges in the United Kingdom --the International Commodities Clearing House (ICCH)-- assumes all risks inherent in futures and options transactions between the members of the exchange. The coverage of the ICCH becomes effective on the day following a transaction, after the corresponding margins or guarantees have been paid.

Owing to the fact that LME is oriented preferentially to serve the needs of the metals industry and to the important participation of these interests in transaction of the exchange, the latter obtained certain flexibility on the part of the SIB for the operation of the clearing house.

The most important flexibilities refer to the fact that brokers may discriminate in the treatment of different types of clients. For example, where industrial clients are concerned they may opt that the account not be segregated (differentiated from other accounts that the broker maintains). The non-segregation of various accounts allows the broker to compensate internally the positions of various clients and therefore diminish the collection of variation margins from his clients. The usual form adopted for this mode of operation is that the broker grants his client a line of credit that covers eventual negative margins up to a certain amount, depending on the volume of operations and the client's solvency.

Another aspect that differentiates the operation of the LME from other futures exchanges is that the clearing house pays only positive price differences on the date of the contract's expiration. In other words the LME is not a cash-cleared market, which has at least two advantages: it makes the margins system more flexible and reduces the impact of speculative positions on the market.

At the beginning of 1989, the regulatory body for the commodity exchanges in the United States --the Commodity Futures Trading Commission (CFTC)-- reached the beginning of an agreement with the SIB for broadening the possibility of fiscalizing operations of North American brokers on exchanges in the United Kingdom. This agreement would oblige the LME brokers to segregate the accounts of their clients in the United States. This rule was strongly resisted by the LME and its users because it would increase the costs of operation on the exchange.

The adoption of the clearing-house system meant in addition that, for the first time, the LME could count on an information system that would register all transactions effected, not only in the official rings of the exchange but also the inter-office transactions effected by the brokers. These transactions represent a significant volume of the total, although prior to 1987 they were not registered in the statistics of the exchange (see table I.1).

Contracts, terms and official prices

At present the LME transacts future contracts for seven metals: copper, aluminum, silver, lead, zinc, nickel and tin. The tin contract was suspended in October of 1985 and reinstated in July 1989. For zinc there are two contracts depending on quality specifications (see annex I.1 and chapter II). In addition, in 1987, the LME introduced options contracts for each of the metals mentioned, except tin. Since 1987 futures contracts have been officially transacted on the LME for three, and also 15, months periods, in addition to cash transactions. The three months contract is the traditional one and that which concentrates greater liquidity. A unique feature of the LME is that during the three months it is possible to make contracts that expire on any intermediate day instead of the usual system of monthly expiration. Beyond the three months, the expiration date is the third Wednesday of each month. This system permits users to make transactions with more flexible expiration dates than in other futures markets, which results in greater facility for making sure that hedging coincides with the physical trade. The extension of the term of contracts to 15 months diminished the incidence of the so-called "white contracts", which were made directly between a broker and his client and thus outside the control of the exchange.

After the close of the official work day of the LME, the brokers act as market makers, extending the transaction hours in order to amplify possibilities of operation for users in the Far East and the United States. The interoffice transactions are made by telephone and, increasingly, through interconnected computers, on the screens of which the prices offered by each broker appear (screen market).

There are two official sessions of the LME and in each one there are two rings for each of the contracts. The morning session extends from 11.45 a.m. until 13.15 p.m., and in the second ring of this session, official prices are established for the different metals. The afternoon session begins at 15.20 and ends at 16.40. The rings for the different contracts last five minutes each. At the end of each session, the so-called "kerb trading" takes place, when during 15 minutes, all contracts are transacted simultaneously.

The official prices or "settlement prices" for each contract are announced by the Quotations Committee at the end of the second ring in the morning. This Committee is formed by three members of the exchange who are rotated weekly. The Committee decides what were the last bids and offers at the close of the respective ring, for the different terms (cash, three months and 15 months). The Committee has the power to reject the last prices of the ring if it considers that they are not very representative of the market's tone at the moment. The Committee's decisions may be questioned by other members, leading to a process of arbitrage.

Administration and types of members

The reorganization of the LME meant important changes in its administrative structure. Until 1987 the LME was administered by a Committee of Subscribers which represented the company's stockholders. This Committee was formed by the so-called "ring-dealing members", i.e., those who could operate as principals in the Exchange rings. Although there was a stockholders' Board of Directors, the Committee had the real power.

In 1987 the LME was obliged to adapt its administration to the requirements of operating officially within the framework of the new regulations. A new company was formed, the London Metal Exchange Limited, with a single directive body of an executive nature (Managing Board) and one full-time official (Chief Executive). In addition to the Chief Executive, the Managing Board is composed of 14 persons, of which 10 are members of the Exchange and four are connected with metals industries and invited by the Exchange.

The new administrative structure reflects the intention of the LME to professionalize management and incorporate different interests of the brokers in high-level decisions, getting away from the image of a club that it had projected in the past. However, the executive power continues to be exercised by the brokers, although with greater internal and external counterweight than in the past.

Simultaneously with changes in its administration, the LME changed the categories of membership, introducing various new categories and thus tending to facilitate the participation of a larger and more diverse number of firms.

Prior to its restructuring, there were only two categories of members in the LME. There are now seven categories. The most important is that of ring-dealing members who can operate in the rings and control the directorate. Two new categories are those of Associate Broker Clearing Member and Associate Trade Clearing Member, which cannot operate directly in the rings but are members of the Clearing House. Then there are the categories of Associate Broker and Associate Trade Member, which do not entail operative privileges but permit participation in the administration of the Exchange. Finally, there are the individual and the honorary members.

The eligibility requirements for each of the categories of membership are different. The major requirements are for the ring-dealing members, not only in terms of their commercial and financial situation (at present the minimum patrimony required is one million pounds sterling) but also of the stipulation that it must be a company established in the United Kingdom. However, there is no nationality requirement, and so it is permissible for the company to be a subsidiary of a foreign firm.

In reality, of the 20 ring dealers now in the LME, 18 are owned by foreign parent companies (most are American, German and Japanese firms).

The category of Associate Trade Members is that which is best adapted to the needs of metals producers and consumers who desire to participate more actively in the institutionality of the exchange. The requisites for this category are quite accessible. Members must have a minimum patrimony of 50 000 pounds sterling and pay an annual quota of 1 000 pounds. At present various producing and consuming firms participate in this category. Among developing countries, membership includes MEMACO, the copper trading firm of Zambia and Chile Copper Limited, a subsidiary of the Chilean Copper Corporation.

2. The New York Commodity Exchange-COMEX

a) Historical evolution

COMEX is much less important than the LME in the non-ferrous metals trade. The reason for this is that COMEX is a futures market oriented fundamentally toward speculators and investors rather than toward the metals industry. In fact, of the only two base metals transacted in COMEX --copper and aluminum-- only the copper contract is important for a segment of the industry. However gold and silver futures are transacted in COMEX and these contracts are very active, due to their interest for speculators and also because they are used by the precious metals industry for hedging operations (see tables I.2, I.3, I.4 and I.5).

COMEX was created in 1933, after the fusion of several exchanges that were transacting metals futures in New York. Subsequently, in addition to the metals mentioned above, zinc and tin futures were transacted, although they were later suspended. At present COMEX is the third largest futures market in the United States and accounts for about 75% of the volume of futures transactions for metals.

b) Present organization

Transactions system

The COMEX transactions system is similar to that of the rest of the futures market in the United States and quite different from that of the LME. The main operating characteristics of COMEX are:

- All transactions are effected through their own clearing house. The positions are daily balances and the payment of variation margins is cash-cleared daily.
- The contracts are a standard type, that is to say deliveries of different qualities of metal are accepted.
- The futures contracts have monthly expirations.

These characteristics basically tend to satisfy the liquidity needs of speculators and investors. The contract specifications are the broadest possible and the monthly expirations --instead of daily during the first three months, as in the LME-- are an attempt to limit the possibilities of manipulating the market. Margin requirements are quite rigid. Unlike the situation prevailing in the LME, there is no flexibility with respect to the charging of margins by the brokers, although it is possible to pay the initial margin through the deposit of financial instruments of the United States Government. The exchange periodically sets the original margins for each contract, depending on price levels and volatility. All transactions are differentiated according to whether they are speculative or for hedging, and margin requirements for the speculative ones are higher.

Another important difference is that in COMEX there is a cash-cleared market, which means that there is a daily settlement of positions. In other words the positive differences that show a future position are paid daily, instead of on the date of the contract's expiration, as in the case of the LME. It is often said that this characteristic would tend to increase the price volatility by permitting speculators to finance the increase in their positions with the margins they receive.

Contracts, terms and prices

A future contract for copper is now being transacted in COMEX and since 1983, there has been one for aluminum. In 1986 official options for copper started to be transacted. As mentioned before, one of COMEX's characteristics is that its contracts are of a "standard" type, that is to say they are defined for a base quality, but they accept the delivery of other qualities of copper and aluminum, with pre-established premiums and discounts with respect to the base quality. An innovation occurred with the introduction, in July 1989, of a contract for high-grade copper (see details of contracts in annex I.1 and chapter II).

Both contracts are transacted for the following terms: the current month (the so-called "first position", equivalent to the cash price of the LME), the two following months and various additional months within the 23 months following the current month fixed by the exchange. (Actually these months are January, March, May, July, September and December; they are the so-called active trading months.) The new contract for high-grade copper is

transacted during the first 12 months with the intention of having it fit in better with the LME operations.

In contrast with the LME, the COMEX functions in a continuous session between 9.25 a.m. and 14.10 p.m., New York time. Each metal is transacted in its own pit and the volume and price of each transaction is registered on a screen at the Exchange, while various media communicate with the outside. At the end of each session the settlement price for each of the contracts is known.

COMEX has authorized warehouses only within the United States; these are distributed throughout the entire country in both producing and consuming centres.

Administration and members

COMEX distinguishes four groups of members: the commission house group, the trade group, the floor brokers, or floor group, and the general group. In turn, members may choose to belong to the clearing house.

All requests for membership must be approved by the Board of Governors of COMEX. The requests must be from individuals, although individual members may subsequently confer their rights on firms. At present 106 firms are members of COMEX.

In order to become a member, it is necessary to comply with the financial requirements fixed by the Board of Governors. Candidates must be recommended by two members. In the case of non-United States residency, they must be recommended by two resident members and two members of firms in the candidate's country. Once accepted by the Board, the candidate must buy a seat on the Exchange; these are freely traded. At the end of 1988, the cost of such a seat, which would permit transacting futures and options, was US$132 000 (a seat for options only cost US$50 000).

The COMEX Board of Governors is composed of 25 persons, seven from each one of the member groups and four that are not members. COMEX has an administrative staff larger than that of the LME and headed by a Chief Executive. Various committees answer to the Board. One of them is the Non-Ferrous Metals Committee, in charge of relations between the Exchange and the copper and aluminum industries in matters pertaining to contracts for these metals.

As a result of changes in the copper and aluminum markets and of the need to maintain a competitive position vis-à-vis the LME, in recent years COMEX has been more receptive to suggestions from industries for these metals, particularly the copper industry. The result has been the introduction of various modifications in contracts in order to adapt them to the industry's hedging needs.

COMEX, like the rest of the futures markets in the United States, is under the regulatory authority of the CFTC, a federal government agency. Its mission is to protect the rights of users of futures markets, impeding price distortions and avoiding market manipulation.

In order to achieve these objectives the CFTC is endowed with broad regulatory powers: it authorizes the functioning of commodity exchanges, approves and can modify internal regulations and approves futures contracts. In case of emergencies the CFTC can intervene in any futures market and take the measures it deems necessary.

Internal regulations of COMEX establish maximum limits on positions that may be maintained by users and on daily price variations.

II. THE ROLE OF EXCHANGES IN THE NON-FERROUS METALS MARKETS

This chapter analyses the role of the exchanges in physical markets for non-ferrous metals. The analysis focuses on the function of the exchanges as generators of reference prices for the metals trade; this function determines in large measure the benefits that industries can obtain from greater utilization of the exchanges. The chapter begins by defining the different types of reference prices used. It then proceeds to an analysis of the recent evolution of reference prices for each metal and the growing importance of prices on the exchange. Finally there is a discussion of the degree of participation of metals industries on the exchanges.

A. REFERENCE PRICES FOR NON-FERROUS METALS

1. Functions of reference prices

A reference price may be defined as a formula accepted by the majority of the buyers and sellers, as a basis for determining the commercial transaction price (Gibson-Jarvie, 1985). In the metals markets, the primary function of a reference price is to serve as a basis for evaluating purchase-sale contracts between the different market agents: producers, processors, final consumers and traders. In contracts for these products, the reference price is generally called the "base price". Over this base price the premiums, or discounts, based on degree of processing, quality, final destination and other contract variables are applied.

As is the case for other products, for each metal there is more than one price. The existence of different prices is due, among others, to factors related to the degree of competition in the market, the geographical location of the industry, different quality of the product and rates of exchange. This makes it possible that, for the same metal, two or three different reference prices can prevail. For example, in the United States, copper is traded at the COMEX price, and in the rest of the world at the LME price. For the aluminum, zinc and nickel trade, producers prices as well as those of the exchanges, are used. Many examples of this situation are found in the metals markets (see section B).

The decision as to which reference price should be used will depend, in the last instance, on the degree of agreement between participants in the market concerning which best represents the conditions of supply and demand. In this connection, it is difficult to find a reference price that satisfies equally producers and consumers, since each group has its own needs and interests. When an exchange price is in question, it is more difficult to satisfy all of the participants, since it is necessary to reconcile the interests of the metal industry with those of the speculators participating in the market.

2. Types of reference prices

Reference prices in the metals market may be classified in accordance with the way they are determined, as follows:

a) Producers prices. These prices are fixed unilaterally either by a formal association or an informal group of producers, and therefore are properly those of industries with oligopolistic characteristics. Although the "leader" price may be fixed for one or more producers, the rest of the producers tend to follow it.

b) Controlled prices. These prices are fixed by the administrative authorities of a country (for example, prices fixed during emergencies or wars).

c) Negotiated prices. These prices result from direct negotiation of a contract between the seller and the buyer. The prices negotiated are used preferentially for products which, being sold in large volumes and over long periods, require more stable prices in the long run. This is the case of iron ore and of bauxite.

d) Publications prices. These are prices published by specialized communications media, the origin of which is the information gathered by the publication from the participants in a market. The published prices are generally "transaction prices", since they are calculated on the basis of prices of contracts actually realized. The principal publications of international reference prices for non-ferrous metals are the Metal Bulletin, in London, and Metals Week in New York.

e) Exchange prices. These correspond to future contract quotations on the metals exchange. The reference price is generally the official cash quotation on the exchange but in addition future quotations or an average of these are utilized.

In practice there are situations that cannot be classified precisely. For example, the International Tin Council intervened in the LME in order to maintain the price of tin within a pre-determined range. Although the reference price was that of the

LME, this price was managed by a group of producers and consumers. Some copper producers in the United States still maintain a producers price but this price is adjusted to COMEX variations. Similar price determination takes place in the case of lead and zinc.

On the other hand, for contracts covering physical products frequently a combination of two types of prices is used. This is at present the case for nickel which uses the LME price, but within certain ranges agreed on by the producer and his client. In aluminum contracts the price of the LME, combined in a specified proportion with the producers price, is used as the base price.

3. Determinants of the type of reference price utilized

In recent years different types of reference prices have been used in the metal markets. There have been changes in price formulas for almost all the non-ferrous metals, with a tendency toward greater use of exchange prices and other market prices, to the detriment of formulas administered unilaterally by producers. This tendency is due to changes, not only in the market structure of the different metals, but also in the international economy.

a) Market structure

The market structure for non-ferrous metals, in particular the degree of concentration of supply, is the determining factor of the reference price used. The more concentrated the industry the easier it is to use a producers price formula. Depending, among other factors, on how extensive the coverage of a producer or a group of producers may be over the total metal supply, and on the degree of vertical integration of the industry, a producers price can be determined unilaterally.

Experience shows that almost all the non-ferrous metal markets have gone through stages where producers prices have prevailed. This is explained by the high degree of concentration in primary production that was characteristic in these industries until the decade of the 1970s. Some industries, such as the aluminum had in addition a high degree of vertical integration. During the 1950s and 1960s it was common practice for a group of transnational producers to control, permanently or temporarily, the prices in the international metals market. Toward the beginning of the 1970s the nationalization processes of subsidiaries of mining transnationals in the developing countries, and the appearance of independent producers all over the world, eroded control of the large mining transnationals over their markets. The markets became more competitive and producers gradually lost their power to fix prices. In other cases, such as that of the International Tin Council,

unrealistic price objectives weakened discipline among members and ended in the failure of the Agreement.

To the extent that producers prices lost credibility or simply disappeared, they were replaced totally or partially by prices that more adequately reflected the market. In many cases this vacuum was initially filled by publications prices and later by exchange prices.

b) External factors

Structural changes in the non-ferrous metals markets coincided with important changes in the international economy. The greatest has been instability of economic variables, which increased the risk of trade and financial operations. Price variability caused the growth of speculative activity in the futures markets and the utilization of these markets in order to cover industrial risks. The opportunity to fill the vacuum left by producers prices, the greater need of the industry to cover its risks and the possibility of attracting speculative interest favoured the appearance of new futures contracts and their gradual acceptance as reference prices. Examples of this tendency are the introduction, in the LME, of their contracts for nickel (1977) and aluminum (1979).

B. THE RELATIVE IMPORTANCE OF EXCHANGE PRICES IN THE NON-FERROUS METALS MARKETS

1. Copper

a) Historical review

Changes in the predominance of one or another price system in the copper market have reflected the evolution of the organization of this industry over time. As for other metals, a producers price predominated for copper, while the industry showed high concentration in a few important producers. However, free market prices did exist at the same time: in fact, from 1983 onward a standard copper contract was transacted on the LME and even before this time there were informal copper transactions in London, on a cash basis and for deferred delivery.

As the industry was becoming less concentrated, free prices were gaining in relative importance as reference prices used in direct supply contracts between producers and consumers. An important event in the deconcentration of the industry was the nationalization process of the 1960s and beginning of the 1970s. But even before this some governments of exporting countries had

pressed to change the reference in the contracts from producer price to free prices.

In fact, as a consequence of the sudden increase in demand in 1964, the LME price rose very much above the North American producers price, which was used as a reference by various producers in Africa and in Latin America. The COMEX price followed that of the LME but below it. Then the Government of Zambia and that of Chile forced foreign companies to change the base price, taking first the future price at three months of the LME, and then the cash price (see table II.4).

Since then, the system of producers price was restricted, practically, to the internal market of the United States. Between 1973 and 1974 the United States Government imposed controls on internal copper prices, which resulted in producers prices that were notoriously lower than that of the LME or of COMEX.

The predominance of producers prices within the United States was maintained until 1978, the year when Kennecott and other producers decided to abandon it, in order to use COMEX as a base. Various other North American producers maintained list prices, but they began to follow very closely the COMEX price. Today there are still some producers and consumers who sell and buy according to producers prices determined daily in relation to market alternatives, including the COMEX quotation.

The standard contract for copper on the exchanges has been evolving along with technological changes in production and consumption, although with certain delays and in processes that are not exempt from conflict.

Toward 1880 the "good merchantable brands" was established in the LME as an unofficial reference for exchange contracts. In 1898 a single standard contract was established for fire-refined copper having a content of 99% to 99.3%, with a premium for electrolytic copper and discounts for copper of lesser contents. This contract was the norm until 1963, when three contracts were introduced: wirebars, cathodes and fire-refined. The wirebars contract accepted two grades: electrolytic and high-conductivity fire-refined.

Since then changes have been more frequent. A minor change was the termination of the contract for fire-refined in 1968. In 1981, after various years of meetings, the LME changed copper contracts, establishing one for high grade and another for standard.

This change was due to the expansion in the use of the continuous-casting process, which permits passing directly from a high quality cathode to the wire rod that is the base for the manufacture of electric cables. With this the wirebar began to lose importance as a raw material for the manufacture of electric articles. High-quality cathodes began to be transacted directly,

but without an adequate counterpart in LME contracts. Therefore the "wirebar" was used as a base with discounts, and then, as the market situation evolved, with premiums. The premiums reflected greater demand for high-quality cathodes and likewise reflected the fact that the wirebars that continued to be produced, and above all those that remained in warehouses of the LME, had as raw material cathodes of inferior quality. The quotation was becoming less and less representative of the quality necessary for use in continuous casting.

On the other hand, the wirebars contracts of the LME was not accepting delivery of high-quality cathodes. If a manufacturer had an excess of high-quality cathodes on hand, he could sell it only against the cathode contract, at an important discount with respect to its real market value. The cathode contract of the exchange was reflecting inferior quality, appropriate for non-electrical uses.

The Intergovernmental Council of Copper Exporting Countries (CIPEC) participated actively in bringing about a process of change in the LME contracts. The discussion process was started in July 1978 and took a long time until finally the LME adapted itself to the market change introduced by the diffusion of the continuous casting process.

In 1986 the denominations Grade A and Copper Standard were changed and, in 1989, the Copper Standard Contract, by then seldom used, came to an end. The reason for this is that demand for material of low quality has been declining and producers have responded by increasing quality, with the result that very little material is now available that would qualify for the lower-quality contracts.

The volume of transactions and inventories of the Copper Standard Contract decreased drastically between 1983 and 1986 (see table I.1). In the latter year, the Grade A contract was introduced, with the result that various brands of wirebars that previously were registered as higher-grade copper were incorporated into the standard contract. This material temporarily increased inventories of this contract, but in 1987 they disappeared almost completely. As of 1 April 1988, the standard grade contract has been amplified in order to accept delivery of fire-refined copper. However, the volume of transactions did not increase and finally it was decided to terminate it.

b) Present situation and tendencies

Copper is transacted on three official exchanges: the LME, COMEX and the Mid-America Commodity Exchange of Chicago, the latter affiliated with the Chicago Board of Trade. Some United States firms continue to publish list prices, which are adjusted to the COMEX price very frequently. When they are not adjusted officially

there is a tendency for premiums and discounts to be included in the direct contracts which serve the same purpose of staying close to the market.

The dominant price in the copper market is that of the LME. In the United States traders use the COMEX price, which is closely linked by arbitrage to that of the LME. The Mid-America contract is not very liquid because it has not been successful in attracting speculative interest, nor been used as a reference in direct contracts.

A high-quality contract began to be transacted in Mid-America in May of 1986, similar to the LME contract and permitting deliveries in the warehouses of the LME in Europe. It has not resulted in the attraction of sufficient interest, in part because, as a reaction, the COMEX likewise introduced a high quality contract. The opinion of COMEX executives is that there is scarcely room for two competitive contracts in the United States.

While the LME attracts a larger proportion of transactions of producers, consumers and traders, COMEX attracts a larger proportion of speculative transactions. This fact is reflected in the characteristics of the contracts in each of the exchanges. The COMEX contract is more attractive for speculative interest, because traditionally it has accepted a wide margin of brands and forms of copper, with fixed premiums and discounts (see annex I.1 on contracts' characteristics). The date of delivery of a contract is any day of the month. These characteristics ensure great contract liquidity but they make the instrument relatively unattractive as coverage or as a physical market of last recourse.

Recently COMEX has introduced a High Grade contract similar to the Grade A contract of the LME, satisfying industry's requirements and allowing better arbitrage with the LME. The intention of this change was to consolidate the use of COMEX on the part of industry. Until now the COMEX price has been used within the United States preferentially by investment and speculative interests not linked to industry. Internationally it is used by arbitrators and by Peruvian, Chilean and Mexican producers, who use it as a price reference in their sales to the United States.

In January 1988 the LME established a warehouse in Singapore. This decision has given rise to a discussion of the effects of geographical dispersion of the warehouses of the LME on the representativity of its price.

The problem arises because there is a difference of about four weeks maritime-transport time and of about US$40 per ton in transport cost between the warehouses in Europe and the warehouse in Singapore. Since the LME contract gives the seller the place-of-delivery option, the LME price will represent the least attractive warrants price, which will be that of the place

circumstantially resulting less attractive. Thus, if demand is slow in the Far East, European consumers will obtain only warrants on Singapore at the LME price.

The direct contracts establish a place-of-delivery option for the buyer, on a CIF Europe basis. If, due to circumstances, the LME price is not representative of deliveries in Europe, producers will try to add a premium, which will be resisted by consumers. On the other hand, products with less processing, such as blister and concentrates, contracts for which are based on the LME contract with discounts, will be deprived of this compensating premium. The alternative proposed by some producers is the establishment of regional metals exchanges located in centres of high consumption, among them Japan. Copper contracts would be transacted there copying exactly those of the LME. In this way the price of each regional exchange will reflect local conditions but at the same time would, through active arbitrage, maintain the differences between exchanges at a value within a range based on the cost of sending material from one warehouse to another.

Thus it definitely would not be necessary to add on a premium according to delivery place. The objection to this proposal is that high liquidity in the regional exchanges is not sufficiently assured to induce the basing of direct contracts on prices established there. The location of exchanges in high-consumption centres is at least a necessary condition for the success of the contract, but it is not clear that it would be a sufficient one.

Another aspect refers to the fact that of the 19 warehouses authorized by the LME for copper, only three account for more than 80% of inventories. Several of them are not used at all and some are used very little. However, their existence depresses the contract price because there is always the possibility of receiving a warrant from a badly-located warehouse. There is a proposal to restrict the number of official warehouses to those that have the most movement due to being located in large consuming centres (Bravo, 1988; Munita, 1988; Normark, 1988).

Although most copper trade takes place in dollars, the copper contract continues to be transacted in pounds sterling. The producers and various consumers have suggested the advisability of changing the currency, as has been done in the case of other metals, in order to avoid the cost and the risk of operating in an additional currency. The LME is about to announce its decision concerning the proposed change.

Some producers want to make it more difficult to introduce new grades in the copper contract. The price is representative of the worst grade that the seller wishes to deliver, so that the acceptance of a grade of lesser quality would cause the price to be less representative and oblige the introduction of additional quality premiums. In reality, it has been suggested that the

restriction not be discretional, but that it be included in the rules of the LME.

In various markets special prices prevail. In developing countries where there are import restrictions, internal prices reach premium levels with respect to the LME price. The same thing happens in Japan, which protects its foundries and refineries and uses tariff revenue on imports of refined copper in order to subsidize small, internal, high-cost mines.

In Germany there is a price known as the DEL Notiz (Deutsche Elektrolytkupfer fur Leitzwecke), which is calculated daily on the basis of the highest and the lowest prices paid by 19 copper manufacturers, thus being a range of prices. This price is used by the cables industry and most of the industry producing other semis. It is composed of two parts: the LME settlement price, and the highest and lowest premium paid in the contracts with copper producers. It is estimated that, in most sales of manufacturers to their consumers, the price of the copper content is based on the lower limit (over 95% in the cables, and over 80% in other semis).

Since 1987, standard option contracts have been transacted not only in the LME but also in COMEX. Previously there had been options contracts put out by firms specialized in metals, but those contracts did not have liquidity in a secondary market.

2. Aluminum

a) Historical review

The aluminum industry is the one where a system of producers prices has been maintained for the longest time without interruption. The industry was dominated by five large producers (the majors) without serious counterweight until the decade of the 1970s. These five groups --Alcan, Alcoa, Kayser, Reynolds and Pechiney-- controlled almost 60% of the supply of aluminum. In addition they were integrated in the different stages of production: extraction of bauxite (the mineral raw material), refining of alumina, production of aluminum and manufacture of semimanufactures.

The aluminum market is geographically segregated: bauxite deposits are found preferentially in tropical zones and, therefore, the developing countries are the major producers. The refining of bauxite into alumina which was originally performed in the consumer countries gradually came to be located close to bauxite production, owing to cost considerations. The production of aluminum, on the other hand, is mainly concentrated in the consumer countries, but in the last two decades production of the developing countries has increased significantly. Aluminum production requires a large

amount of energy and therefore it has tended to be situated close to hydroelectric energy sources (see tables II.5 to II.8). The price policy of the majors was directed toward expanding demand for aluminum, replacing other metals in traditional uses and encouraging the use of new aluminum products. Through control of the cost of bauxite and alumina, as well as of the aluminum market, producers who were integrated managed to carry out their price policy and regulate long-term profit of the industry. Although the aluminum industry has one of the lowest returns, consumption grew at a rate of 10% annually in the 1960s and 8% in the 1970s.

During the 1950s and 1960s, reference prices for aluminum, that were the most utilized in the United States, Europe and Japan were the Alcoa List Price and the Alcan World or Export Price. Direct contracts between independent producers and semimanufacturers were long term (5 to 20 years). Although there was no flexibility with respect to the reference price, the buyer had the possibility of diminishing the quantities contracted and producers offered discounts. This practice came to be known as the "fair price system". The control of the majors over the aluminum market began to be eroded by a series of events starting in the 1960s when the Soviet Union became an exporter of aluminum to Europe. Soviet aluminum was sold by merchants below the producer prices and thus a "free market" arose beyond the control of the producers. In those years, the English publication Metal Bulletin, introduced the quotation "Certain Other Transactions" (COT) to serve as a reference price for this new market. The COT is defined for aluminum of 99.7% purity and is calculated on the basis of transaction prices between traders, consumers and producers (see table II.9).

In an attempt to maintain their control over the market, the majors negotiated with the traders a gentlemen's agreement, in which the former committed themselves to buy Soviet aluminum at the COT price.

Producers continued to lose control as a consequence of the increase in alumina refining and, later, the production of aluminum in the developing countries and Australia. The new integrated projects in Brazil, Venezuela, India and Australia meant an increase in aluminum sold on the free market through traders or independent firms. The availability of alumina, in turn, permitted the increase of independent aluminum producers in the consumer countries.

The growing importance of the free market led the LME, in 1978, to decide to introduce a contract for aluminum. This decision was strongly resisted by the producers, since they foresaw that their producer price would be weakened and they feared that this would contribute to increasing price instability, thus discouraging consumption.

The recession at the beginning of the 1980s sharpened these tendencies. The lesser demand resulted in greater availability of alumina in the free market and greater capacity for processing aluminum. Traders took advantage of this situation to contract the conversion of alumina in foundries with idle capacity, selling aluminum and semis of aluminum in open competition with the integrated producers. In addition, after the second petroleum crisis, the Japanese aluminum producers lost their ability to compete and had to procure their supplies through participation in integrated projects in the developing countries or the free market. The terms of direct contracts were shortened and increasingly market prices were used for reference. Initially these were combinations of the COT and producer prices, and then, to a greater extent, the price of the LME.

In the United States the free market used preferentially the Mid-Western Merchant Price (for aluminum of a purity of 99.7%) published by Metals Week. In 1983, the COMEX introduced its future contract for aluminum hoping to attract participation of the North American industry and give place to arbitrage operations with the LME, in a form similar to that of the copper contracts. However, the COMEX contract never attracted the necessary liquidity (see table I.1). Probably this was due to the relatively small size of the free aluminum market in the United States and also because the contract was introduced at a moment when the market was low and there was no speculative interest. Moreover the existing restrictions for imports from the socialist area made difficult the internationalization of COMEX contracts.

b) Present situation and tendencies

i) Metallic aluminum

Most contracts establish as a reference price a combination of market prices and list prices, although there is a tendency toward greater utilization of the LME prices, especially among new producers, such as Brazil and Venezuela. In Europe and the United States the frame contracts, permitting the quarterly renegotiation of prices and quantities, are customary. The Alcan price is now denominated "transaction price", which indicates that it is based on effective transactions and is not a "list price". Pechiney established the system known as PIP, which is an index of market and producers prices applied over a base price. Since 1985, the Japanese processing firms and trading houses have been buying mainly at the LME price. LME-based contracts use the cash quotation as well as that for three months.

Until 1988 there were two contracts for aluminum in the LME: one for 99.5% pure introduced in 1978, and another added later for high grade. This latter contract, called High Grade Primary

Aluminum, refers to metal with 99.7% purity, in various forms, and in lots of 25 metric tons. All grades of aluminum that are registered on the exchange and fill the technical specifications are accepted as good delivery, and prices are quoted in United States dollars. Since 1987, the LME likewise transacts aluminum options (see annex I.1).

The increasing use of the LME price in the Far East led to the establishment of a warehouse in Singapore in 1988 and, in September of the same year, the LME approved the opening of warehouses in Japan, which started operating in July of 1989. In parallel action, the large Japanese Trading Houses for aluminum prepared a study recommending the establishment of a metals exchange in Japan, the Japanese Metal Exchange (JME).

The COMEX contract has until now been the standard type. It refers to a certain grade of metal (P1020A) but accepts other qualities at a discount. With the intention of making the contract more attractive, COMEX has decided to restrict aluminum qualities that constitute good delivery and increase the size of the contract from 40 000 to 44 000 pounds. These changes were made in September 1989 and brought the characteristics of the COMEX contract closer in line with those of the LME (see annex I.1). The LME itself is analysing the possibility of opening warehouses for aluminum in the United States.

ii) Alumina

Transactions between subsidiaries of integrated producers continued to be approximately 50% of the market. These sales take place at transfer prices based on cost considerations. The free market includes contracts with independent producers as well as the majors (mainly Alcoa) and other producers of alumina. The terms of contracts with independents have been shortened and the reference price is linked to the price for metallic aluminum. A customary formula is base prices related to the cost of production of alumina, plus an escalator that refers to the price of aluminum. Towards the middle of the 1980s 70% of contracts included escalators linked to the price of the metal. The present tendency is that independent producers buy alumina on the basis of LME prices.

iii) Bauxite

As in the case of alumina, most trade takes place intra-firms, at transfer prices, but there does exist a free market for bauxite with negotiated prices. Traditionally the majors purchased with long-term contracts, at prices related only to the cost of production of bauxite. Gradually the producers increased their negotiating power, introducing formulas that incorporated the price

of aluminum. An important instrument was the International Bauxite Association (IBA). An important reference price in the free market for bauxite is the "Boke Price". Boke is a mine in Guinea that accounts for almost half of the free market. Boke sales contracts establish a base price as well as a formula that includes cost escalators, the price of alumina and that of the metal.

3. Zinc

a) Historical review

At different times, producers prices as well as exchange prices have prevailed in the zinc market. While the zinc industry does not have the degree of vertical integration which prevails for that of aluminum, the large primary producers as well as the independent smelters (custom smelters) have an important degree of control over the market. The primary producers --who sell part of their production as zinc concentrates and part as metal that they refine internally-- are located preferentially in Canada (Cominco and Noranda), Australia (Australia Mining and Smelting), United States (St. Joe and Asarco). Among the developing countries, the main producer is Peru, through the State firm CENTROMIN. The independent smelters dominate the European market (Asturienne des Mines, Metallgesellschaft, Preussag, Vielle Montagne, Billiton and Penarroya). In Japan there are integrated producers such as Mitsui Mining and Smelting, but most are independent foundries (see tables II.10, II.11 and II.12). These firms are also the principal producers of lead, a mineral that is frequently found together with zinc.

The control of the market by the firms has likewise been facilitated by the low incidence of scrap recovery in total supply (approximately 7% of production of refined). In addition, the industry established, in 1960, an intergovernmental consultory organ --the International Lead and Zinc Study Group (ILZSG)-- which has contributed to achieving more stable market development. The effectiveness of this organ has been attributed to the active participation of representatives of firms as advisors to the official delegations and the predominance of private firms in the industry (Webb and Zacher, 1988).

Since the beginning of the century, the LME has transacted various zinc contracts and, until 1964, its price dominated as a reference price outside of the United States. The increase in zinc prices between 1963 and 1964 (see table II.13), was of concern to the industry due to its effects on demand in a moment when aluminum was replacing zinc in some applications. Therefore the European foundries established a producers' price system, the European Producers' Price (EPP). The EPP was published by the Metal Bulletin on the basis of prices of all producers who sold in Europe. The

basis was called the zinc "gob" (good ordinary brand), had 98.5% purity, and served as a reference not only for metal sales but also for the purchase of concentrates. This was essential so that the foundries could adjust their raw materials purchases to the sales price of the metal.

The abrupt fall in demand, and of prices, starting in 1974, caused an increase in competition within the industry, which in turn meant that integrated producers had to sell at a discount below the EPP. This resulted in contradictions between these producers and the European foundries which had to sell the metal at a lower price than that of the concentrates. The situation gradually eroded the EPP, which began to follow more closely the LME price, and concentrates began to be sold on the basis of the latter, or a combination of this with the EPP. In 1984, the LME introduced a contract for high grade zinc, which in 1986 totally replaced the old standard quality contract.

In recent years contradictions between integrated producers and the European foundries have been aggravated due to the growing discrepancy between the EPP and the LME price. The disparity between quality specifications of the High Grade contract (HG) (99.95%) and the dominant quality in the European market, Special High Grade (SHG) (99.995%), likewise complicated the coverage of the foundries and the semimanufacturers for premium charges over the HG quotation. The European foundries pressed the LME to introduce a contract for zinc SHG that could be used as a reference price for purchasing concentrates and selling metal. Responding to this problem, the LME established the SHG contract for zinc in September 1988.

b) Present situation and tendencies

Shortly after the LME introduced the new contract, the principal European foundries announced that, starting in 1989, they would utilize this quotation as a reference price for sales of metal and purchase of concentrates. The change was resisted by the integrated Canadian producers who argued that speculation in the LME would increase the volatility of zinc prices. Finally, the LME price began to be used as a reference, starting on 1 January 1989, at which time the EPP price ceased to be published (American Metal Market, 1988).

The metal contracts as well as those for concentrates in the European market, and increasingly in the Far East, used this price as a reference. In the United States, a producers price has been maintained --the United States Producer Price-- published by Metals Week, which is a weighted average of prices for the sale of HG quality metal.

At present the LME transacts two zinc contracts. The High Grade contract accepts delivery of zinc with 99.950% purity in different forms and in lots of 25 metric tons. Only trade names registered on the exchange are accepted and the contract is transacted in dollars. The special "High Grade" zinc contract has the same characteristics as the preceding one, except that it is defined for a purity of 99.995%. The LME likewise transacts an options contract in zinc (see annex I.1).

4. Lead

The lead industry is closely related to that of zinc because a large part of the primary production of both is carried out jointly, and most zinc producers are also producing lead. However the lead market is more competitive, due to the high percentage of scrap in total production of refined (between 35 and 50% depending on the market) (see tables II.14, II.15 and II.16).

For a long time the price of lead was similar to that for zinc but demand for lead stagnated and the price of zinc rose. The LME established their contract for zinc in 1903. The present contract "Refined Pig Lead", is defined as lead with a purity of 99.97% (see annex I.1).

This quotation is the reference price for all lead trade outside the United States and is used for concentrates, scrap, and refined metal. Activity under the contract is fundamentally that of the industry, the presence of speculators being very low (see table II.17).

5. Tin

a) Historical review

Tin transactions in the LME date from the time it opened in 1877; in October of 1985 they were suspended, owing to the tin crisis, and were resumed in June 1989.

The metal is also transacted on the exchanges in Malaysia, the Kuala Lumper Commodity Exchange (KLCE) and the Kuala Lumper Tin Market (KLTM). The KLCE has been transacting futures contracts since 1987 but their volume is still very small. The KLTM is a physical tin market for immediate delivery, in which there are no future transactions. In 1984 it replaced the Penang Market, which had been functioning since the beginning of the century.

The tin market was dominated for years by the International Tin Council, an association of producers and consumers. In the 1920s and 1930s, producers managed schemes that restricted

production in order to maintain prices. Since the beginning of the Second World War, the United States has been accumulating a strategic inventory, which in 1955, contained the equivalent of two years consumption (see tables II.18, II.19 and II.20).

In 1956 the First International Tin Agreement was signed, with the support of the United Nations, but without the participation of the United States or the Soviet Union. In the 1960s and 1970s there was a marked increase in tin consumption and successive five-year agreements between producers and consumers, with a coverage above 80% of the market, managed to stabilize the price within increasing price ranges. Between 1977 and 1980 the price rose above the ranges of the International Tin Agreement, after regulatory inventories were exhausted. Gradually new producers entered an attractive market with successfully-defended prices. In 1985 the coverage of the Agreement had dropped to 55% of the market and at the same time consumption had begun to decline, in part, as a consequence of artificially high prices.

The price began to decline in 1980. Then, in the middle of 1981, a mysterious buyer (who turned out to be the producer firm Malaysian Mining Corp.) started to accumulate large amounts of tin, pushing the price up. The Agreement fixed a minimum limit in accordance with new market conditions. When, six months later, the mysterious buyer began to sell, the price dropped below the established limit and the Agreement's stabilization fund had to start purchasing.

The United States had signed the fifth agreement in 1975, but in 1980 it withdrew. As a result, the sixth agreement was never signed and many members of the Council never paid their quotas. The disbursement in 1981 and 1982, added to the lack of contributions from members, left the stabilization fund with scarce resources and it had to recur to borrowing.

Despite production cuts, the market situation did not improve; the stabilization fund finally could not obtain more credit and withdrew from the market. The Council left debts for 900 million pounds sterling and an inventory of 52 000 tons of metal, in addition to future purchases for 63 000 tons, at an average price of 8 900 pounds per ton. The Council and the member countries refused to confront the debts.

The LME suspended transactions, as did the KLCE. After several months of negotiations, the LME decided to fix a price of 6 250 pounds per ton (the free market price at that time) for purposes of settling pending commitments (ring-out). The metals traders lost about 260 million pounds sterling and the banks about 160 million.

b) Present situation and tendencies

After the price fall that marked the tin crisis, prices had shown a modest increase starting at the beginning of 1986 (see table II.21). Despite the greater uncertainty concerning the future price of tin, prices have not been very volatile. The Association of Tin Producing Countries, with the support of Brazil and China as observers, has fixed production quotas, starting in March 1987, and these have contributed to maintaining and stabilizing prices. They likewise have contributed to gradually diminishing excess inventories which had accumulated, up to 1985, as a consequence of operations of the Tin Agreement's stabilization fund.

On 1 June 1989 tin transactions on the LME were renewed. The KLCE has, since 1987, been transacting future contracts with terms up to 12 months. Although there is little movement, the volume of transactions has increased in recent years. It is possible that, with the re-opening of the LME, the arbitrage business will result in greater movement.

The two Malaysian foundries in the KLTM are auctioning their production to local and international traders and some steel manufacturers. The bidding starts at the highest price offered and then goes down until all the material has been sold. Delivery takes place within two months, once the material has been cast. Until recently only raw material originating in Malaysia was transacted in this market, but today that originating in Indonesia and Thailand is also negotiated.

The Metal Bulletin has maintained a biweekly quotation that is representative of the free market; this became very important after the LME and KLCE suspended quotations in 1985. However, some find that the published prices do not totally reflect conditions of the market, since this is at present not very liquid.

It is estimated that, since the tin crisis in 1985, more direct relations between producers and consumers have been established and that the role of the intermediaries has diminished.

6. Nickel

a) Historical review

Until 1969, producers effectively managed a producers price, under the leadership of the INCO, International Nickel Company Ltd. of Canada, which was the largest producer, with more than 50% of the market, although its market coverage declined over time. Since then the producers price has been losing importance, owing to an over-supply which lasted until 1974. In 1978, INCO abandoned the producers price and after a few years there was a return to the

practice of publishing list prices, although these are not very significant.

The rest of the producers tended to offer a discount with respect to INCO price, in the form of somewhat more favourable transport conditions. Apart from the producers price, smaller quantities were transacted at free prices, coming from small producers --Cuba, South Africa and Rhodesia-- and exports from the socialist countries (see tables II.22, II.23 and II.24).

Starting in 1960 the Metal Bulletin has published a free market price based on reports from the principal traders. For its part Metals Week published for many years, a producers price for North America; this practice was discontinued in December 1987 (see table II.25).

Starting in July 1977, nickel for immediate delivery was transacted in the LME. The forward contract of the Exchange was introduced in April 1979 and from the beginning attracted great movement, in spite of the fact that the producers boycotted it. The producers considered that an exchange price would affect the direct relations that had always existed between producers and consumers and that the speculative elements would generate considerable fluctuations in price. However, the Soviet Union used that quotation from the beginning.

b) Present situation and tendencies

The price of nickel has recently shown a phenomenal rise, in a proportion of one to four, which has generated problems for consumers. Although the processors pass the price increase along to the final consumers, so spectacular a rise generates resistance.

In order to cover their exposure to nickel price increases, steel manufacturers have begun to charge an overprice linked to the market price of this metal. On the other hand, a final consumer, General Motors, has decided to buy directly the nickel that it requires and then sell it, at market prices, to manufacturers from whom they have traditionally bought steel products. The idea is that, being an important consumer of nickel, they will have some power to get better prices.1/

Support of INCO and the LME by producers shows that today they have a receptive attitude towards the prices of the exchanges. In order to accommodate consumers, they have offered a price system based on that of the LME but with maximum and minimum limits. These limits are soft, in the sense that, if the LME price goes above them, or below them, then a charge is applied which is an average between the limit and the LME price.2/ The requisite for acceding to this system is to agree to a long-term purchase programme, so that the benefit of the system operates in both

directions. Producers are concerned that consumers accept this price system only when the result is a price that is lower than that of the free market, and that they are not disposed to pay more in periods of lower free prices.

The system was started by INCO, which has been followed by Japanese producers. Initially not much enthusiasm was awakened among consumers by this initiative; they hesitate to commit themselves to long-term supply contracts and in particular they worry about having to face periods of low free prices for competitors who are supplied totally on the free market, thus leaving them outside the market. Price differences of raw material can reach levels that are much higher than the profit margins in steel production, so that a processor cannot face a situation where his supply price is higher than that of his competitor.

For this reason, every raw material processor requires a uniform price system. A high price however, although uniform, has a global effect on the consumption level of his products and thus there is a balance between uniformity and level.

The aim of the INCO proposal is to moderate extreme prices, but it does not ensure uniformity. In fact, various consumers have decided to commit only part of their future requirements to the INCO system, leaving the other part uncommitted in order to supply themselves at market prices.3/ Thus, in high price situations each processor will be buying at a combination of different prices, which generates a complicated competitive situation.

It is estimated that until recently between one-half and one-third of sales were realized at prices other than those of the free market. However, producers prices have been declining in importance and, in fact, the price of North American producers published by Metals Week was suspended in December 1987.

The LME contract --primary nickel-- accepts nickel of 99.8% purity in the form of cathodes, pellets or briquettes of trade names registered on the exchange. There are official quotations for cash contracts and futures for three and 15 months. In addition, in the LME an options contract for nickel is transacted (see annex I.1).

C. PARTICIPATION OF METAL INDUSTRIES ON THE EXCHANGES

This section analyses the participation of the metals industries on the exchanges and, in particular, the degree of utilization of these within the Latin American region. It should be noted that this analysis is limited by difficulties encountered in access to the necessary information. This results mainly from the fact that the information is treated as confidential by exchange users and

brokers. Moreover, the LME does not register transactions in a way that would distinguish those that are for hedging from those that are speculative and there is even less identification of users. Concerning Latin American participation, the available information is very fragmentary and should be complemented by a study with specific information on the situation at the regional level. This task is beyond the scope of the present document.

1. Operative participation

The degree of utilization of the exchanges by the metals industries, or segments of them, depends on many factors. Among them are: the extent to which users can cover themselves effectively against price risk associated with the physical trade; national regulations concerning access to exchange and futures markets; the size of the firms and their degree of exposure to price risk; the possibility of financing margins and guarantees required by the exchanges; and the level of knowledge concerning operations of futures markets.

The copper industry is probably that which participates to the greatest extent on the metals exchanges. The utilization of the LME quotations as a reference price for copper, over a long period of time in practically the entire world, has determined the greater degree of utilization of the exchange on the part of the industry. However, as in the case of the rest of the metals, the segments that used it most are those that are facing greater exposure to price risk. Among these are the manufacturers of semi-processed products (hereafter referred to as manufacturers), the independent foundries and refineries and the trading firms.

The use of the exchanges by primary copper producers is more recent, but has increased considerably in the last decade. Traditionally, the trading policies of primary producers did not consider price hedging. In part this was due to the existence of producers prices and a lack of knowledge about exchange operations. As industry became more competitive and prices more unstable, producers found it necessary to recur to the exchanges in order to diminish the negative effect of price fluctuations.

The participation of the copper industry of the developing countries has traditionally been low but, following the world tendency, it has increased in recent years. Within Latin America, firms in Chile, Peru, Mexico and Brazil regularly use the LME and the COMEX in order to effect hedging.

In Chile, the National Mining Corporation (ENAMI) is probably that with the largest volume of operations. This is explained by the fact that it is an independent refinery. ENAMI buys minerals and concentrates from small and medium-sized producers, processes them and later sells the metals on the international market.

Therefore their profit depends on adequate hedging of their purchases and sales. ENAMI has developed great experience in future markets for copper, gold and silver. In addition to covering its own operations, it has extended the possibility of hedging through ENAMI to many medium-sized producers that otherwise would have difficulty gaining access to the exchanges.

For its part, the National Copper Corporation of Chile (CODELCO) has likewise increased its presence on the exchanges since the beginning of the 1980s, but for various reasons it has been limited in their active use. However, the LME is used regularly by subsidiaries through which CODELCO participates in joint ventures for the manufacture of copper wirerods in Germany and France. Recently CODELCO formed a new subsidiary with headquarters in the United Kingdom (CODELCO Services Ltd.), one of the functions of which will be to centralize all hedging operations of productive European affiliates; it is foreseen that later on CODELCO services will amplify their operations toward the trading field, which undoubtedly will result in a greater need to use the exchanges.

In addition to these two firms, most large and medium-sized private copper producers in Chile frequently use the LME and the COMEX.

In Peru, 65% of copper production is controlled by foreign firms, some of which probably operate on exchanges. The rest of the production is traded by the State firm Minero Comercial (MINPECO), which acts as sales agent for medium-sized and small private and State producers. MINPECO also acts as a trader, buying part of the production for its own account, which it later sells on the international market. This same system is likewise applied for lead and zinc. Until 1981, MINPECO had a monopoly of Peruvian minerals and metals trading. When the monopoly came to an end, the volume sold by MINPECO diminished (from almost 100% to 50% of Peruvian mining production), and at the same time the use of the exchanges declined.

At present, MINPECO is competing with international traders who in addition to offering better purchase terms to producers, frequently include, as part of their services to them, pre-shipment financing and price-fixing options. The lesser activity on the exchanges is due likewise to important losses suffered by the firm as a result of errors in its silver coverage operations during the manipulative incident of the Hunt brothers.

In Mexico, the copper industry uses mainly COMEX, due to the fact that most of its sales are on the North American market.

The importance of the LME in the aluminum industry is much more recent. The exchange is used mainly by traders, the Japanese trading houses and, increasingly, by independent aluminum

producers. Among the majors, ALCOA has admitted recently that it utilizes the options contract of the LME, whereas ALCAN has still resisted using it, claiming a lack of liquidity (Metal Bulletin, 6 June 1988). Some producers likewise have formed trading subsidiaries which have been relatively successful (Mining Journal, 20 January 1989).

In Brazil and Venezuela, the largest producers of aluminum in Latin America, the firms base their contracts preferentially on the LME price. A large part of these firms are joint ventures between the State, the majors or Japanese consumers (VENALUM and ALCASA in Venezuela, and ALBRAS, VALESUL, and Aluminio do Brasil in Brazil). Part of the production of these firms is tied up in long-term contracts and is traded by subsidiaries of the majors. The rest is sold independently and probably a portion of this is covered in the LME.

The case of the tin industry is special. There, as in that of copper, the LME price has prevailed for a long time. However due to the structure of the industry, the LME was used for coverage mainly by traders. The industry operated on the LME for a long time, but in order to maintain the price, through the stabilization fund of the International Tin Agreement. The Malaysian Mining Corporation, for its part, likewise carried out a manipulatory operation on the LME during 1981. The markets of Malaysia, the KLTM and the KLCE are utilized preferentially by Malaysian producers and some traders.

Following the crisis of the Bolivian industry, the largest tin producer in Latin America is Brazil. The main Brazilian producer is the private firm Paranapanema which controls almost 65% of refined production. In 1981 it formed a trading firm --Paranapanema International-- and in 1983 began to operate on the LME (ECLAC, 1988). In Bolivia, direct participation in the LME is much smaller. Since a large part of Bolivian production is bought and sold through traders, it is possible that producers have price-fixing options in the contracts.

2. Institutional participation

Traditionally the participation of the metals industries as members of the exchanges has been scant. In recent years, however, this has increased, through the incorporation of producers as members and also through greater influence on decisions affecting the industry.

In the LME, some producers participate as ring-dealing members but all belong to large transnational conglomerates involved in both production and the trading of minerals and metals (Mitsubishi, Mitsui, Metallgesellschaft, Billiton-Shell). Various producers and manufacturers had been incorporated into the new category of associate trade member. Members from developing countries include Memaco Services Limited, the trade subsidiary of the State firm of

Zambia and Chile Copper Limited, the subsidiary of CODELCO in the United Kingdom. MINPECO of Peru is considering its incorporation as a member of the LME. The industry likewise participates in various ad hoc committees set up in the LME in order to analyse matters related to contract modifications for each metal.

Furthermore, following the restructuring of the LME directorate, four directors have been incorporated in representation of the metals industry. One of them is an employee of Memaco.

In COMEX, the participation of the industry is less. At the member level, only Asarco, of the United States, is a primary producer. Of the developing countries, the only member is the National Bank of Mexico (for operations in gold and silver). In recent years, the copper industry has increased its influence over COMEX, as demonstrated by changes introduced in futures contracts.

III. BENEFITS OF GREATER USE OF THE METALS EXCHANGES

In this chapter, the main benefits that the metals industries can obtain from greater use of futures markets will be analysed. In section A, the different problems and objectives that primary producers and processors face in the production and trading of minerals and metals will be discussed. Section B contains a description of futures markets operations that can be used to solve those problems. Finally, in section C, the different ways of acceding to futures operations and the characteristics of intermediaries offering those services are considered. The focus of the analysis is on trading problems of primary producers, who make up the most relevant segment in the Latin American region.

A. PROBLEMS IN MINERALS AND METALS TRADE

1. Introduction: the price risk

One of the main problems facing the non-ferrous metals industries is the risk inherent in the variability of metals prices. In the case of primary producers, once the mining project is under production, most of the other fundamental problems, such as reserves and costs, have already been resolved. On the other hand, the price risk remains, since this usually is known only in the moment of selling the production. Even for low-cost producers, whose risk of loss is lower, the extreme fluctuation of their profits is undesirable.

For their part, the processors also are exposed to price risk. For example, the independent foundries and refineries are buying raw material, processing it and later selling it. During the period when they are processing the raw material and until they sell the processed product, they are exposed to price variations (for example, the experience with lead, zinc and copper, see chapter II). Their problem is to synchronize the purchase price with the sale price. The traders and manufacturers of semimanufactures are in the same situation. The manufacturers of final-use products are also exposed to price risk, but its magnitude depends on the incidence of the metal in the total cost of the product.

At the country level, the same thing occurs. The economy of the developing countries tends to depend, in an important way, on the fluctuating income from their exports of minerals and metals, profits of operations of State firms, and taxation of private firms.

It seems obvious that not only primary producers, but also processors, desire to avoid price risk. But this expresses itself in diverse objectives, depending, among other factors, on the size of the firm, its property and the philosophy that inspires its management.

However, in mining firms the objective of income stabilization should always be present because, in contrast to other producers, the mining company acquires an important part of its inputs starting with the initial exploration of the deposit. It is in reality the owner of a mineral inventory in the form of reserves. As such, its patrimony is exposed to the risk of price variations of those reserves, which obviously is linked to the price of the mineral extracted. Consequently, the producer is in an exposed position not only with respect to his inventory of refined metal, or with respect to production planned for the period, but also with respect to a stock of raw material for a long production horizon. The preceding applies in a similar way at the level of mineral producing countries.

Operative leverage

The price risk and, therefore, the propensity of the different segments of the metals industry to utilize the exchanges in order to cover these risks, depends on the value added to mining production. Therefore, the exposure of primary producers to price risk is less where mineral reserves are concerned than where refined metal is ready for sale. The greater the value added to the raw material, the more exposed the producer is with respect to price variation of the final product, because he has incurred in additional expenditures in order to move the reserves up to the metallic state.

As more value is added, the operative leverage increases; that is to say, the profit fluctuation is each time greater than the price variation that originated it. Owing to this leverage effect, producers have more incentive to protect the profit margin associated with their inventories ready for sale, than their inventories in process, and, finally, the production planned for the near or distant future.

For the same reason the independent foundries and refineries and the manufacturers are facing greater operative leverage, to the extent that their profits depend on the margin between the cost of the raw material and the sales price of the refined metal. Hence

the incentive to cover their physical operations in futures markets will be greater.

An extreme case is that of traders whose business depends on selling at a price higher than that at which they purchased. For them, hedging is indispensable, unless they decide to assume a speculative position in the physical commodity (Fry, 1984).

2. Aims of primary producers

a) Obtention of the annual average price

Among primary producers, it is customary that the explicit goal of their trading should be the obtention of the average annual price of the metal. Obviously, this price will be the reference price used by the firm, compensated by the applicable discounts or premiums, depending on the type of product sold. For example, a producer of zinc and lead concentrates will try to keep the base price of his physical contracts as close as possible to the respective annual averages of the LME.

There are several reasons why a producer should elect the obtention of the average price as his objective. One of them is the preference for achieving the annual market average, since this is considered to be the representative level for the maximum price obtainable without having special trading abilities that would permit rising above the average level in a particular year.

Another reason is that a firm with comparative advantages and that, therefore, is among those with lower costs within the industry, will not necessarily be interested in fixing in advance a certain profitability, while losing the possibility of sharing in price increases. This type of firm is interested in obtaining the average price over long periods, avoiding the catastrophes of very low prices.

In practice, reasons such as the preceding ones, combine to explain why many primary producers have little interest in fixing future prices. For example, large Latin American producers, such as CODELCO in Chile, have as an explicit sales policy, the obtaining of the annual average for copper on the LME.

Producers who pursue this objective try to fix a price at quantities similar to their physical production each month. However, inevitable imbalances occur, as a consequence of variations in production and/or sales, delays in transport or the application of contractual systems of price fixing different from the average reference price for a particular month. Their objective then is to correct these imbalances that distance them from the

annual market average, for which purpose they can recur to operations on the metals exchanges.

b) Fixing profitability

The objective of assuring in advance the profitability of future production, fixing prices in futures markets, is expressed in different ways, depending on the characteristics and situation of the firm. For example, low-cost producers who have as their main goal the attainment of the annual average, can occasionally fix the price of part of their production in order to assure a profitability that they consider to be extraordinarily attractive.

Other firms have the goal of fixing their profitability for some months in the future, if prevailing future prices generate for them an acceptable profit. With that they avoid sacrificing their profitability in case of adverse price movements, but likewise, they lose the possibility of sharing in increases. (However the options markets can solve this problem.)

Among those who seek the stability of a longer term, are the relatively high-cost producers. In general, these are small producers with limited resources for facing periods of low prices. They do not have the productive flexibility to respond to price variations nor do they have access to borrowing in order to subsist while producing during the cycle of low prices. This is the case of the small and medium-sized mining sector for lead, zinc, copper and tin in Latin America. These producers are those that mainly benefit from a greater utilization of the metal exchanges, but at the same time they are the ones who face greater limitations for doing so.

Another group of producers that needs to assure its future profitability within a known range is made up of those who must finance the construction of a new mining project or carry out expansion of existing projects. The obtaining of financing for a project will be facilitated if it is possible to know in advance the cash flow that it will generate. For this reason it is of interest to these producers to have the possibility of fixing the price for their future production. The term of hedging will depend on the costs of the project and the term for repayment of the debt. The international tendency to finance mining investments through indebtedness rather than with accumulated capital has increased the need to carry out operations that will permit fixing prices for relatively long terms.

c) Influencing the price

A different objective from the previous ones is that of wanting to influence the price level in a particular market. This is an objective to be expected of a group of producers with

oligopolistic power over the market. Producers price systems are a way of obtaining this objective without recurring to futures markets, as has been the case in many metal industries. On the other hand, the stabilization scheme of the International Tin Council is an example of how exchanges can be used to try to manage the price of a metal.

The desire to influence a price can have different objectives. One of these is the maintenance of a high price level stemming from the fact that in a group or cartel it is common to find firms with relatively higher costs (the case of tin), or from the fact that the firms with small reserves benefit through collective measures to raise the present price, even at the cost of pressing down future prices that they anticipate will not affect them.

Another objective is to achieve greater price stability in the long run. A country, a group of firms or an individual firm that has large mineral reserves with respect to present production and moreover has low production costs, has a long-term link with the future of the industry, since reserves are sufficient to produce for a long time. A firm or country of this type will be interested in the harmonious development of the industry in the medium and long term, thus permitting realization of the profits promised by the reserves. This objective may be expressed, for example, in the desire to intervene on the exchanges in order to avoid a price rise above a certain level that could negatively affect consumption of the metal and to impede that it fall below the level that would assure profitability for the low-cost producers. This type of schemes has been considered in many metals industries, particularly in that of copper.4/

d) Speculation

Interests linked to the non-ferrous metals industries occasionally carry out speculative operations on the metals exchanges. A separate case is that of those metals traders for whom speculation forms part of their normal activity. The traders may speculate either by taking a physical position without coverage on the exchange or by taking speculative positions in futures contracts that do not have a physical counterpart. Producers and processors also speculate on the exchanges, but only marginally and occasionally, based on a certain vision of the market's probable evolution and with the aim of realizing an extraordinary profit.

3. Aims of the intermediate processors

The price risk faced by the intermediate processors (foundries, manufacturers and traders) is of a different type. They buy raw material, process it, and then sell it. During the period intervening between processing the raw material and selling the

processed product, they are exposed to price variations. Moreover, the value they add is relatively small in relation to the price of the raw material, making the operative leverage very large. Their fundamental problem is to maintain over time a sufficiently profitable relationship between the purchase price and the sale price. Traders and manufacturers of semimanufactures are in the same position.

Another important objective of the intermediate processors and the traders is to finance their raw material inventories, which likewise can be achieved through use of the futures markets.

B. SOLUTIONS THROUGH EXCHANGE OPERATIONS

1. Simple coverage with future contracts

a) Operation

The hedging operations permit eliminating or reducing price risk involved in purchase or sale through transactions in futures contracts. The producer for example is interested in hedging his future production or inventories of physical goods against possible price declines. In order to achieve this, he fixes a price in advance, selling futures contracts for a volume equal to that of his inventories or his production. At the expiration of the futures contracts, the producer delivers the goods on the exchange and receives the price fixed in advance.

Now only rarely is the contract actually fulfilled through delivery of the goods on the exchange. The usual practice is that the operation is liquidated through the repurchase of the future contracts on the date of expiration or earlier, whereas the physical goods are sold to the final consumer in a separate but simultaneous operation. The concept of fixing the price is, however, the same. In reality, in this last way the profits in the short position in futures compensate for the losses in the physical goods position, in case the price has dropped. Profits in futures are realized by liquidating the operation on the exchange through the repurchase of the futures contracts at the moment of the sale of the physical inventory. In the same way, if the price has risen, the futures position will result in losses while the physical goods position will show gains of the same magnitude.

The opposite type to sale hedging, or "short hedging", is the purchase hedging used by processors. Purchase hedging, or "long hedging", involves the purchase of futures contracts in order to be protected against an increase in price that can occur before the moment of physical purchase. This hedging is used by processors of

raw materials in order to fix their price in such a way as to be able to indicate in advance a price for their processed goods.

Whether it be for purchase or sale, hedging consists of establishing a position in a future contract, approximately of equal volume, but in the opposite sense, to an existing or anticipated physical position, for the purpose of protecting a profit margin in the face of a possible adverse price change.5/

b) Cost of hedging

Hedging avoids price risk but requires incurring in certain costs. Those of intermediation include commissions and financial costs of margins and are relatively small.

In addition, there is the cost of non-participation in speculative profits, should the price move favourably, against the gain of not losing if price should move in an adverse direction. This can be a determining element for abstaining from covering price risk. In fact it is not easy for a manager to explain to shareholders that the firm has not benefited from price increases because he decided in advance to fix a lower price through exchange operations.

It is even more difficult for the manager of a State firm to face this situation and to have to give explanations to the government and public opinion. The manager will be criticized on all sides and the ex post result confused with the alternatives that the manager faced ex ante. The consequence is that the manager appears to be taking the price risk on his own shoulders, which puts pressure on him to abstain from hedging the price risk for the firm. It definitely is easier to explain a bad economic result as a consequence of a cause beyond one's control, such as the price's movement in the international market, although in reality the manager has had futures markets for covering that risk.

It is not always taken into account that insurance against price risk requires paying a premium, although this is what happens with any insurance. An individual who is adverse to risk must be prepared to sacrifice part of his anticipated income through incurring in insurance cost for the purpose of making his income less variable. In hedging operations this is a hidden cost, because the premium is neither explicit nor simple to calculate. It is included in the future price since this is lower than the price expected for three months later.6/

c) Residual risk

Often it is not possible to eliminate totally the price risk; residual risks remain, of lesser relevance in comparison with the

price risk, but not to be disdained. These risks are due to an imperfect coincidence, or fit, of product quality, geographic location, or liquidation period of the operation.

Regarding the quality of the material, a difference is generated if the physical product is not equivalent to the contract quality on the exchange. For example, there is a tendency to charge a premium for a sale of copper cathodes of a quality superior to the specification of the contracts on the London Exchange. The value of this premium cannot always be fixed in advance. In the annual contracts between producer and consumer, the premium is contemplated, but this is not the case for sales not covered by an annual contract. The seller then remains subject to the risk of variation in the premium level, which moves in accordance with supply and demand for high quality cathodes.

Apart from this, when cathodes delivered on the exchange are of a quality superior to the contract specifications of the exchange, the quality premium is lost. A buyer who wishes to withdraw a specific quality from the exchange usually must pay a premium.

Something similar occurs with geographic location. The seller takes advantage of having material in a more convenient place, thus saving on transport cost. On the other hand, the buyer who wishes to withdraw material from a particular warehouse usually must pay a premium. There are no mechanisms for fixing in advance the amount of this premium which means there will be a variation risk over time.

When there is imperfect fit in the closure period of an operation, a price-basis risk is generated. The price basis is the difference between the future price and the cash price.7/ Often it becomes necessary to choose a future contract with a duration different from that desired, simply because some contracts have greater liquidity than others. It is also possible that, with new developments, it is decided to anticipate or to postpone the closure of an operation on the futures markets. Consequently, the date of maturity of the future contract may not coincide with the date desired for closure of the physical operation.

The risk of the price basis is generated by the possibility that a surprise may occur in its evolution over time. It is known that, as time goes by and the maturity date of the future contract approaches, cash and future prices tend to converge. That is to say, the basis becomes ever smaller until it reaches zero on the date of the future contract's maturity.8/ But in the meantime, the interest rate, or other factors that determine the level and evolution of the price basis, may vary in ways not anticipated.

When there is perfect convergence and hedging is closed just in the moment of the future contract's maturity, the future price

obtained is that which existed at the moment of opening the hedging. It is customary to refer to this result as perfect hedging. If the operation is closed before the maturity date of the future contract, the risk of the price basis appears. But if there are no surprises in this basis, that is to say, when it evolves in accordance with what is expected in accordance with the structure of future prices in the moment of opening the operation, perfect hedging is still obtained.9/

In order to avoid the risk of variation in the price basis, the producer could establish a special contract with his client. In such a contract, the future price prevailing at the moment of delivery would be specified as reference, instead of the cash price at the moment of delivery, as is customary, plus (or minus) a fixed difference (or basis). In this way, the closing price of his hedging in the futures market is annulled by the reference price of the contract, leaving a difference the value of which has been established in advance. The purchaser in this operation also annuls his basis risk. This method has been used in aluminum and zinc contracts. In the 1960s some copper producers fixed the future price of the LME as reference.

In order to avoid the risks of variation of the basis to which a processor is subject, it is possible to obtain a locking of the spreads in an operation with a broker. An example is the case of a processor, where the transformation period is two months, that is to say he purchases material and after two months sells a more processed commodity. Traditional hedging would consist of: i) selling a future contract for the same quantity and on the same date when the metal is purchased, and with a maturity date of two months; and ii) after the two months, to buy, cash, the same quantity, coinciding with the sale of the processed commodity.

The locking-the-spreads operation differs from traditional hedging where the operation takes place once, for several months, through a broker. The contract with the broker hedges not only the sale but also the subsequent purchase. For the sale, for example, 12 deliveries by the processor to the broker are established, from January to December, where the January delivery price corresponds to the price of the preceding November plus a spread locked through mutual agreement. In the same way, for the other months the price is fixed according to the two months cash price plus an agreed spread. For the purchase, 12 deliveries by the broker to the processor are established, from January to December, each one with the price of the same month.

Obviously there are no deliveries, only liquidation of price differences. The result is that the processor gains the spread less the broker's commission, since the processor fixes prices in exactly the opposite direction in the physical operation. On his side, the broker covers himself more and more on the exchanges, but assumes the risk of variation in the price basis, since he

committed himself with the processor in a locked spread. The commission received has a premium component which pays for this risk.

Very similar operations are at times motivated by the need to finance maintenance of an inventory. For example, a producer or a trader who must maintain inventories, can take advantage of the spread in order to finance his inventories, selling future on the exchanges. Then at the moment of selling the physical goods, he repurchases on the exchange. With this, the effective price that he obtains is the cash price at the moment of making the first operation on the exchange, in addition to the spread which compensates for storage and financing costs.

Finally, mention must be made of the residual risk due to the difference between the price offered and the price demanded (bid/offer spread). This difference is not constant; it increases when there is less liquidity for a particular contract, or when its price in the short term is very volatile.

d) Speculation with future contracts

If it is estimated that there is sufficient information available in order to anticipate that a price increase is more likely than a decline, then the producer or processor may take a speculative position for all, or a percentage of, his physical operation. To this end, he will hedge with futures contracts only a part of the physical volume, or in an extreme case, none of it. If he speculates on only a part of the physical volume, he takes a partial price risk, avoiding an eventual disastrous result if the price should move in the direction not expected; at the same time he hopes to generate a speculative gain. The size of the speculative position will depend on his confidence in the information available to him and the probabilities he assigns to a price increase.

Futures markets also permit taking positions on the movement of the price basis. Although these are proper activities for speculators, producers and processors also engage in them on occasion.

The basis may change because of a variation in interest rates or other components of the cost of maintaining inventories, or it can result from changes in supply and demand factors (see annex III.1). Through the purchase of a short-term future contract and the simultaneous sale of a future contract with a later maturity, a bet is being made that the basis will increase. If this happens, when the two contracts are closed simultaneously a positive difference obtains, since the future price in the contract with the later maturity date rose more (or fell less) than the future price of the closer maturity date.

In a similar way it is possible to speculate with the movement of the basis between contracts of different exchanges or of different products that are related either in their production or their consumption.

e) Arbitrage operations

Arbitrage is an operation that consists of taking advantage of a price difference in order to make a gain without taking a risk. The opportunity arises when a price moves away from its equilibrium level. Some arbitrators are specialized in arbitrating futures prices of a single raw material (intracommodity arbitrage), comparing the price difference with the financial and storage costs involved in acquiring an inventory and maintaining it. If the difference is greater than these costs, it will be advisable to purchase inventories in order to deliver them on the expiration date in a future contract. The prices of contract futures at different dates must have a relation to the costs of storage and financing on these dates.

Other arbitrators are specialized in arbitrage between different raw materials (inter-commodity spreads), and between exchanges, for example between the LME and the COMEX. The latter is important for copper.

The rapid action of the arbitrators is the mechanism through which prices are kept in line. It should be pointed out however that arbitrage operations without any risk are scarce. In general the arbitrator will take risks for the spread, or differences, in price between futures of different dates or between different places of delivery. These risks are in any case much smaller than the price risks.

Producers use arbitrage in order to fix the difference between two prices. For example, a refinery in the United States that buys copper concentrates on the basis of the COMEX price, and sells refined copper in Japan on the basis of the LME price, can avoid the risk of variation in the difference between the input price and that of its product by fixing this value through an arbitrage operation.

2. Hedging with options

a) Nature of the options

In 1973 stock options began to be traded on the Chicago Exchange. In the same year an analytical solution was developed for calculating the value of an option (Black and Scholes, 1973). Although with assumed simplifications, the formula permits

calculating the value of options in a very exact way. It is used widely today by participants in this market. Commodity options began to be traded on United States exchanges as recently as 1981.

Long before 1981, there were written options on metals contracts, but outside the formal exchanges. These options are still used for non-standardized business and are known as "untraded options". They are handled by such trading firms as Rudolf Wolf in London and Mocatta Metals Co. in New York. These options do not have a formal market. Whereas the standardized options of the exchanges have a secondary market, it is more difficult to liquidate a position in an option that is "untraded", since it is subject to the desire to repurchase on the part of the firm that launched it.

Except for some in gold, commodity options are written over the futures contracts. In case an option is exercised, normally the metal is not delivered, nor is the respective future contract (although this would be acceptable), until the difference between the cash price and the exercise price established in the option is made up.

An option makes it possible to limit losses through assuring access to potential benefits of a favourable price movement. A call option gives the right, but not the obligation, to buy during a certain period a certain quantity of metal at a price fixed in advance. If the price rises with respect to the exercise price fixed in advance, then it will be advisable to exercise the option, in order later to resell the metal at a profit. If the price does not reach that fixed in advance, then it is preferable to allow the option to run out without exercising it. The loss in this case is limited to the price originally paid for the option.

The difference with a future contract is that it must be complied with whatever the subsequent price movement may be. Therefore the contract has unlimited possibilities for gain as well as for loss. In addition, the future contracts are transacted only at an exercise, or future price, which is such that the contract has a zero value at the moment of its signature. On the other hand, there are option contracts that establish different exercise prices. Obviously these different option contracts have different costs.

b) <u>The option as insurance coverage</u>

The option may be used in the same way as a future contract, with the difference that it is necessary to pay a premium, and that it concedes the right not to deliver (or not to purchase) in case this should be inconvenient.

A producer who desires only to hedge the price risk must evaluate the advisability of using one or another instrument. The option presents the advantage not only of protecting against declines in the quotation, but also of permitting sharing in possible increases. However, it is necessary to pay a cost, the value of the option.

In order to protect the profit margin against price declines, but still participate in possible increases, the producer purchases a sales option (put). A processor, on the other hand, protects himself against price increases of the raw material by buying a purchase option (call).

c) Bidding

Options permit avoidance of contingency risks that futures contracts cannot cover. This is the case of bidding. A processor who wishes to cover a price risk involved in a bid, the result of which will be announced later, must buy a call option in the amount of the material necessary to fill the order. In that way, he fixes a price for this material, avoiding the risk of falling short in his quotation in case the raw material should increase in price in the meantime. But if he does not win in the bidding and, in addition, the price should move against him, he loses only the value of the option. Finally, if the price should move in his favour, he makes a gain for the difference, whether he wins or loses in the bidding. A future contract is not useful for him because it obliges him to take delivery even though he does not win in the bidding.

The call option protects against increases in raw material prices. Examples of users who benefit from the purchase of a call option in order to cover a contingency risk are firms that sell processed products by catalogue, and any others that need to give prices with considerable anticipation, or do not know exactly what volume of sales they will have.

An example of a company that covers itself by buying a purchase option (call) is one which buys through the seller's bid. If it wins the bidding and the price declines, then it has a gain in the option that protects it against the decline. If the price rises, it does not exercise the option. If it does not win in the bidding and the price goes down, it makes a gain; if it goes up, it loses the value of the premium paid.

d) Additional price risks

Often there are additional price risks. For example, the quantity to produce or the date when it will be available can be uncertain. If there is great uncertainty with respect to the amount

that the producer will have available for delivery, it can be advisable to combine a sale hedging for a minimum range, and buy put options for the value of the possible range of variation (or what is equivalent, sales for the maximum range and purchases of call options for the range of variation foreseen). In this way the producer manages to cover the price risk for a variable range of production.

In addition, he shares in price increases, but only for the quantity that he effectively produces above the minimum level foreseen (or he makes a gain if the price drops, for that quantity that he did not produce: he buys in the market at a lower price and delivers at the exercise price).

e) Income generation through writing options

Just as an option can be used to limit losses while maintaining the possibility of sharing in increases, it is possible to use it in the opposite sense: to sell the share in the increases for a convenient fixed price. This can be done by writing a call option. In exchange for income in the form of premiums received, the producer is prepared to renounce the price peaks above the exercise price established in the option contracts, since, in these cases, those who take the option will exercise their purchase right at the exercise price.

f) Speculation through the use of options

Options permit speculating in the metals market with a high financial leverage, since a relatively small investment --the cost of the option-- can generate a gain that is several times its value, while at the same time limiting losses.

Just as futures contracts permit speculating on price tendencies, options permit speculating on variations in the volatility of prices. Through combinations of options, it is possible to construct strategies that will be profitable when volatility increases, or likewise when it decreases.

3. Operations outside the exchanges

a) Mechanisms included in physical contracts

Price fixing

The possibility of fixing in advance the prices for a producer's physical deliveries (copying price coverage on the exchange), is fully utilized by traders in their purchase and sale

contracts for non-ferrous metals. This is possible because the trader effects the corresponding hedging and passes the price on to the producer. Therefore, part of these operations pass through the exchanges in any event, but an important proportion is hedged within the trader's own book.10/

This type of mechanism is used for different terms. The most obvious case is the fixed price sales of a spot lot of a metal (for immediate delivery or shipment). A common form in medium-term contracts (three months to one year) with traders, is that the producer has the option of fixing, in advance of delivery and payment, the price on part, or all, of the tonnage. The term for which he can fix the price will depend on the liquidity of the underlying future market, or the possibility that the trader has for fitting the price that the producer desires to fix with a sale, at a fixed price, to an intermediate processor.

This mechanism, in addition to permitting the saving of operational expenses on exchanges, has the advantage that it can be used for a term longer than that of the future contracts available on the exchange. The disadvantage is that there is a greater risk of non-fulfillment of the commitments acquired. This is so partly because there is no clearing house guarantee and partly because the increase in the term of the contract means that there will be a corresponding increase in the probability that the market price will differ greatly from the price fixed in the contract, which makes it ever-more convenient for one of the parties not to comply.

A more complex variation of the preceding mechanism is the physical sale with deferred delivery but immediate payment.11/ This satisfies the dual purpose of fixing a price for a certain quantity of material that is planned for production, and of obtaining capital resources at a cost that can be lower than traditional lines of credit. It is equivalent to the private sale of a bond that pays in metal.

In some Latin American countries, the proportion of sales to metals traders is quite significant. This is especially the case of medium-sized producers of lead, zinc and tin in Peru and Bolivia. These producers operate preferentially with contracts which include facilities for financing future production. Large firms, private as well as public, also sell part of their production to traders and occasionally use price-fixing mechanisms.

Participation in the price

Options can also be copied through special clauses in physical contracts, such as the "participation in the price" clause. Through this clause, the purchaser participates in price increases over a pre-established level. In other words, if the price surpasses the

pre-established level, the purchaser pays the pre-established price, in addition to a percentage of the overprice. As a counterpart, the purchaser pays a fixed quantity (equivalent to the premium of an option), expressed in another contractual clause.

This type of clause was, for some time, used very much in copper concentrate contracts. In these contracts, the premium paid by the purchaser was expressed in lower treatment charges. The Chilean authorities ceased to accept this type of clause in the 1970s because frequently there was no explicit payment for this advantage. Moreover, the negotiating position of the small producer was weak when he had received advances from the buyer; his limited access to credit tended to facilitate taking advantage of this relationship.

On the other hand, until 1973, there was no analytical solution for calculating the value of such a clause, although today, with the development and extension of the options theory, it can be estimated.

b) Bonds

Coverage through futures has the inconvenience of a very short horizon. Futures contracts are transacted in the market for periods limited to a maximum of about two year at most.

A possible solution is the emission of commodity bonds. A "pure" bond is similar to a future contract. Just like the future contract, the bond promises delivery of an amount of raw material (strictly speaking, its monetary equivalent) upon its expiration. However, the bond is paid in cash, whereas no one pays in the moment of buying or selling a future contract. In reality, the future price is paid upon expiration, in the case of a forward contract.12/13/

The price of a bond that pays a certain amount in the future corresponds to that amount discounted by the risk free interest rate, a rate that accounts for the time value of money. The price of a bond that pays an uncertain amount is less because the value expected (the mean of the distribution) of that uncertain quantity must be discounted by a rate that incorporates a premium for the risk (systematic) to which that uncertain quantity is subject.

A producer who emits bonds of this type obtains a certain and immediate payment, instead of an uncertain future income, selling the price risk and obtaining financing. If the producer would invest the value of the bond sale in risk free instruments, he would then only be selling the risk to which the future income is subject.

In the measure that the future income is only subject to the price risk, the emission of bonds is convenient for a producer whose portfolio is relatively concentrated in metal production. The case is different when the bond incorporates a political risk in the view of the investor. In this case, the price of the bond will be reduced by the political risk. However, since the issuer does not perceive this political risk, it does not appear convenient to him to assume the cost. This tends to be the case of producers in developing countries.

This bond emission scheme has been used, among others, by firms with silver bonds and countries with petroleum bonds (Mexico). The bonds have been somewhat more complex than the pure bonds reviewed here. Various studies recommend the use of instruments of this type (Powell, 1989; Priovolos, 1987). An alternative is that the World Bank emit bonds of this type in the world market, and use the funds to make loans to developing countries on terms linked to those raw materials that make up their main source of export income. This scheme would avoid the political risk mentioned earlier, because the World Bank's reliability is considered by its creditors to be of the first order and because the developing countries do not fail to pay the World Bank, even when they are facing grave crises.

A scheme of this type would diminish the excessive exposure to price variation that affects raw material exports of various developing countries. In addition, it opens the possibility for governments to make loans or swaps with private producers, which would permit the latter to accede to loans denominated in their product, thus avoiding the cost of political risk and the cost of bond emission.

c) Gold loan

The gold loan is a financial mechanism through which a producer may obtain financing at rates lower than those of the banks, committing part of his future production, and at the same time reducing the exposure of his production to the gold price risk. The use of this mechanism in other metals is conceivable. The typical contract extends up to five years, but some have been made for up to seven years.

The operation is similar to a loan expressed in gold, which must likewise be repaid in gold, and yields an interest rate lower than the bank rate. These operations are realized through a metals trader, the term and the amount being negotiated between the producer and the trader.14/ The producer monetizes the gold, selling it to the trader, and with the monetary equivalent of the gold, finances his operations or his investments. On the date of expiration, he pays with gold production coming from his operations.

The financial operation is equivalent to a combination of two operations: one consisting of borrowing on exchanges, that is to say, a cash purchase with a simultaneous future sale; the other is the indebtedness that is necessary in order to make the prior cash purchase. This permits reducing the interest rate of money in the amount of the spread existing for gold in the moment of closing the operation.15/

For the producer, this operation is equivalent to the sale of a bond that is paid for in gold bars.16/ With this he obtains financing and, at the same time, makes a commitment tied to the price of gold which compensates exposure that his production has with respect to this price.

The operation usually requires that guarantees of compliance be established in favour of the trader, and that a commission be paid on the interest rate, in addition to whatever margins or deposits may become due.

This operation may be combined with the purchase of call options with expiration dates that coincide with the calendar for gold return, for the purpose of sharing in eventual gold-price increases.

C. ACCESS TO THE EXCHANGES AND OPERATING EXPENSES

1. Intermediaries

There are different types of intermediaries through which producers and processors may operate on the metals exchanges. The differences among them are mainly their degree of specialization in brokerage services and of participation in the physical metals trade. On the one hand, there are the metals-trading firms which, in addition to their principal activity in the physical market, act as brokers on the exchanges. On the other hand, there are the pure brokers firms that act only as intermediaries on the metals exchanges. Finally, there are the commission houses that are international brokerage firms which participate in futures markets for commodities and in the financial markets.

In practice, the limits between the activities of each type of intermediary are not so clear. During the decade of the 1980s, the businesses of different types of intermediaries have tended to become more diversified. The merchants have developed brokerage services and the commission houses have moved into physical trade. The resultant competition has reduced the importance of the "pure" brokers, especially in the LME.

a) Traders

These intermediaries are firms whose main activity is the physical trade of minerals and metals. Many of them are members of the LME. Traditionally the traders operated only for their own account, in order to hedge their physical businesses and to speculate. Gradually they started also to offer brokerage services to third parties, mainly their clients in the physical market, primary producers and processors. Later, these traders formed subsidiaries specialized only in brokerage.

The principal advantage of operating through this type of intermediary is their greater experience in physical trade, which permits them to offer a more specialized service, in accordance with the peculiar needs of each user. This is facilitated by the physical business that the traders maintain with producers and processors, which permits them to know better the hedging needs of their clients. Moreover, the connection with the physical trade permits them to offer better financing conditions for hedging operations backed by physical contracts. For example, a trader can offer a package of services that includes the physical purchase, as well as a brokerage agreement with a line of credit for financing the margins required by the exchanges.

Another important advantage of operating through trader is that generally this is done "principal to principal". This means, for example, that future operations of a producer imply a direct commitment with the trader and vice versa. The principal to principal operation is possible because the traders maintain their own "book" of future transactions and, therefore, only the balance of operations not fitted into the "book" are covered on the exchange. Operating principal to principal can result in obtaining better executions (obtaining prices closer to the clients orders) and more flexible margin requirements.

One of the disadvantages of operating through trader is the possible conflict of interests that arise because the merchant --who is an eventual competitor in the physical market-- has information about the trade strategy of his client, for example a producer. In the same way, since the trader is not neutral vis-à-vis the market, because he almost always maintains a certain speculative position, the knowledge of operations that he carries out for the account of his clients permits him to take positions in anticipation of the orders he receives from them. For example, an aluminum producer, estimating that the price is at an attractive level, gives a future sales order to his broker. The broker, anticipating a price decline as a consequence of the producer's sales, sells futures for his own account before executing his client's orders. As a result, the producer obtains a lower price.17/

Another disadvantage of operating with traders is that it can reduce the autonomy and flexibility of a producer for commercializing his production. This could result as a consequence of an excessive physical sales commitment, in order to have access to futures operations.

b) Commission houses

As the name indicates, the activity of these intermediaries is the sale of brokerage services in futures and stock markets, for which they charge a commission. Starting in the decade of the 1970s activity of the commission houses increased significantly, due to the giddy growth of the futures markets. The commission houses are mainly in the United States, where the major volume of business is concentrated; however, their international presence expanded considerably during the 1970s and the 1980s.

In the case of metals, the commission houses were oriented almost exclusively toward the speculative clients and their presence on the LME was small. Toward the end of the 1970s some commission houses (mainly Shearson and Merril Lynch) started to attract industrial clients interested in effecting hedgings. For this purpose, they had to operate on the LME. Initially they did this through other brokers, but after the reorganization of the exchange, many have been incorporated as ring dealers or associate members.18/

Most commission houses are members of the COMEX where they have operated regularly for a long time. More recently some have gone into the physical markets, acting as merchants, as in the case of Prudential-Bache. Others have done this by buying existing firms; the case of Deak, which acquired Johnson Matthey.

The advantages that are usually associated with operations through commission houses include the lesser visibility of an individual client's transactions, given the large volume of operations carried out by these intermediaries; in addition, since the latter do not maintain positions in the market for their own account, they have the advantage of greater neutrality. Another important advantage is their geographic diversification, which facilitates access for users from countries with little activity in futures. This factor was important for encouraging users from countries of the Far East and Latin America to initiate exchange operations. Other positive aspects of the commission houses are their greater financial solvency and their charging of lower commissions, as a result of the large volumes of operations carried out.

Among the disadvantages are their limited experience in the physical metals trade and their preferential orientation toward speculative clients, which results in less-specialized attention to

industrial customers. This can be an important inconvenience for users without experience in futures.

c) Others

A direct form of access to metals exchanges is through trading firms owned by producers or processors who are operative members of the exchanges. In the LME, various ring dealers operate in this category. This is the case of Amalgamated (Preussag), Sogemin (Société Generale des Minerais), Rudolff Wolff (Noranda), Billiton-Enthoven (Shell) and Metallgesellschaft. In practice these firms also offer services to third parties and their owners do not operate only through them, in order to avoid that their exchange operations become known.

A particularly useful way that small and medium-sized producers can have access to futures markets is by recurring to the intermediation of a larger firm that does have access to those markets. This is the case, for example, of the National Mining Corporation in Chile (ENAMI), which offers hedging possibilities to producers who supply their foundries and refineries. To the extent that these operations are, up to a certain point, backed by physical-sale commitments, the corporation is in a position to effect them at a much lower cost, in terms of commissions and margins, than would be the case if the producers were to carry them out directly.

2. Expenses of operation

a) Commissions

The amount of commissions charged by the different types of intermediaries acting on the metals exchanges varies depending on the client's characteristics, the type of operation and the metal that is involved. There is also a difference between LME and COMEX commissions.

In the LME, the amount of the commission is negotiated directly by the broker and his client. For copper, aluminum, nickel and silver these do not exceed one half of 1% of the value of the transaction, and three quarters of 1% for lead and zinc. However it is customary that the commission be one quarter of 1%. Its amount can be calculated by applying half over the opening value and the other half over the closing value of the transaction, or alternatively applying the total to the value of aperture or closing. The recent tendency is to express commissions as a fixed amount per transaction (opening and closing).

Another customary practice is to operate on a "net" basis, which means that both parties agree to the amount of the commission, but this is discounted from the price at which the client's transactions are executed.

After the reorganization of the LME, an operations fee (LME fee) was established in the amount of one pound sterling per contract transacted, in order to cover the major operating expenses of the exchange. The brokers charge this fee separately to their clients, but occasionally it is absorbed by the brokers themselves.

In the case of COMEX, commissions are expressed as a fixed amount per transaction and likewise are negotiable between brokers and their clients.

b) Margins

Margins are of two types: "original", those that must be deposited with the broker in opening a position on the exchange; and "variation", that are deposited depending on the price difference between the exchange position and the daily movement of the market. Although the margins do not represent a net cost for the user, they can have an important financial cost. Moreover, some users particularly those from the developing countries may not have the necessary financial resources for covering them.

For a long time one of the main attractions of the LME was that transaction systems between principals permitted operating with very low margins and, in many cases, without margins. In reality, the charging of margins is unavoidable, given the introduction of the clearing house; however, brokers still maintain an important degree of flexibility.

The possibility that brokers maintain the positions of their industrial clients in non-segregated accounts permits them to compensate internally the positions of various clients and, in this way, reduce the charging of margins to individual clients.

The operating conditions between the larger brokers and industrial firms generally stipulate a maximum amount of adverse margins that the broker himself covers through a line of credit he grants to the client. Once the amount of the credit line is surpassed, the client must deposit the margins from his own funds. The amount of the credit line depends mainly on the client's solvency, the size of the brokerage firm and whether exchange operations are, or are not, linked to physical business.

In some cases brokers also accept that, once the credit line is exhausted, the clients cover part of the margins with bank guarantees in favour of the brokers. In addition, it is normal that the brokers pay interest on the amount of the cash margins deposited by their clients.

A firm can minimize the eventual margin requirements by distributing its operations among various brokers in such a way as to take advantage of the possibility that the credit line of each broker cover the maximum adverse margins possible.

In the COMEX the original margins are fixed by the exchange itself and the variation margin is calculated daily. The original margin for speculative operations is greater than that for hedging operations. The amount of each one depends on the price level and the volatility of the market, and therefore they are adjusted periodically. It is possible to deposit the amount of the original margin with financial instruments of the United States Government such as Treasury Bills or Treasury Bonds.

Although COMEX operations impose more limitations than is the case with LME, commercial agreements between brokers and their clients also permit a certain degree of greater flexibility when operations are "principal to principal". This is expressed mainly in credit lines to finance part of the margins.

IV. EXAMINATION OF CRITICISMS OF THE EXCHANGES

In this chapter the criticisms most frequently leveled at the metal exchanges are explained and analysed. These are very similar to those that have been expressed about futures markets in general. They originate in various sectors linked to the metals industry, but mainly come from primary producers and, in particular, those of developing countries. Given the incidence that exports of minerals and metals have in many developing countries, it is frequently the governments themselves of these countries that voice the criticisms. However they do not come exclusively from the developing countries; important sectors of the metals industries of the developed countries also question many aspects of the exchanges' operations. For the effects of the present analysis, the criticisms that most commonly arise may be classified as follows:

- the prices generated on the exchanges are not very representative of the physical markets;

- the exchanges are probably responsible for the increase in price volatility; and

- there appear to be obstacles for operating, and participating institutionally, on the exchanges, especially for the developing countries.

Section A contains a discussion of the criticisms which maintain that the exchanges do not reflect well the fundamentals of production and consumption, because they give great opportunities for short-term speculation, and that therefore the prices are not representative.

In the discussion, the various types of speculators and their reasoning are described; the arguments that blame speculation for the lack of price representativity are explained; standards of representativity are considered; and the criticisms, taking into account objectives, evolution and present characteristics of the exchanges, are examined. In relation to this last element, it is frequently said that prices on the exchanges are not very representative, owing to the operative characteristics of these institutions.

Section B contains a discussion of the problems of concordance between exchange contracts and the physical market, as well as the problems of hedging fit.

Section C contains an analysis of the effects of the exchanges on price volatility. It is argued that speculation increases price instability, a subject related to, but different from, that of the stabilizing or destabilizing effects of speculation with respect to a representative price level.

Finally in section D, there is a discussion of access difficulties for operating on the exchanges, resulting from the margins system (this is of particular relevance for users in the developing countries). The analysis likewise deals with restrictions limiting greater influence and participation of producers on the exchanges, due to requirements imposed for membership in the metals exchanges and the limitations that make it difficult to become a director.

A. SPECULATION AND THE REPRESENTATIVITY OF PRICES

Critics argue that exchange prices are not representative of supply and demand conditions reigning in the physical market for metals. In other words, it is maintained that factors related to production and consumption of the product and the balance between both, as shown by the level of inventories, is not expressed, or is only partially expressed, in the exchanges. These factors are known in the jargon of the futures markets as "fundamentals".

The resultant distortion of prices would have various negative effects, especially on their function as reference prices in the metals trade. These effects are said to include the generation of prices that are permanently lower than those that would prevail if the fundamentals could be expressed completely; similar criticism refers to shorter-term distortions that would give erroneous signals to industry.

The causes of the lack of representativity of prices mentioned by the critics are of various types and, in many cases, condition each other, which makes their analysis difficult. However, the arguments are concentrated on two principal causes:

- the effects of speculation; and

- the operative characteristics of the exchanges.

This section A starts by describing the different types of speculators, the analytical tools that they employ and the reasoning implicit in their action. The discussion continues with an exposition of the criticisms that speculation receives owing to

its effects on the representativity of prices; a discussion of standards of representativity; and finally an examination of the criticisms of speculation in the light of the objectives, evolution and present characteristics of the exchanges.

1. Types of speculators

Before examining criticisms of speculative activity, the different types of speculators, their tools for making decisions and their reasoning will be examined.

Speculators (or non-commercials) do not have direct interest in production, trade or processing of raw material, but rather seek a gain in price movements, unlike those who belong to the trade and who are mainly interested in hedging operations.

a) Rationality in speculation

There are different types of rationality in speculation:

- active strategies based on short-term rationality, that originates in information concerning market performance, combined with other information about the near future, that is supported by technical analysis;

- active strategies based on long-term rationality, originating in information about production and consumption conditions and expectations for them in the future;

- passive strategies based on the conviction that there is a premium for risk taking; and

- operations that do not involve risk (arbitrage).

Speculators specialize in different types of activities. The floor traders or "locals" are the market-makers, who provide liquidity for the market, buying and selling for their own account.

Of these, the "scalpers" buy and sell contracts continuously, looking for small gains on each operation. Seldom do they maintain a position for more than a few hours. Their activity is not reflected in the volume of open positions, because they rarely maintain open positions from one day to another. On the other hand, the position traders maintain open positions for a day or more, looking for gains in short and long-term tendencies. There are some differences in the form of operation between the COMEX and the LME, which are due to the difference in regulations between the two exchanges, the origin of LME being more trade-oriented and that of COMEX more linked to speculation.

The arbitrators take advantage of a price difference in order to make a profit, without taking risks. The opportunity arises when a price moves away from its equilibrium point.

Some speculators are specialized in certain markets, for example, metals, using information concerning the fundamentals as well as that resulting from technical analysis, much of which pertains specifically to those markets (and to the behaviour of the agents operating in them).

Others have no special interest in any market in particular, and arbitrate between different markets, moving from one to another according to conditions. The action of these "global" speculators results in the alignment of the implicit yields in the spreads of different markets, since they are continually analysing which of them offers a better short-term financial investment opportunity.

b) Technical analysis

Speculators operate on bases which have been called "technical analysis" and "fundamental analysis".

The technical analysis is based on a hypothesis concerning the behaviour of agents, the market and the price. It is assumed that the movement of prices within a narrow range forms a "support" or "resistance". The price moves "laterally" within a narrow range when buyers and sellers are in balance. In this situation, when prices rise, sellers are tempted and sell. When the price falls, buyers are tempted.

The "technicians" use also information concerning the volume of transactions ("turnover") and the volume of open positions called "open interest" as aids in the interpretation of price movements, in particular in order to estimate market strength or the number of persons interested in the market at different prices.

If the price and the volume of transactions are rising, this is interpreted as a sign for optimism, but if the volume is low, the opposite occurs.

The volume of open positions confirms the signal given by the transaction volume if it moves in the same direction. But if the volume of open operations increases while the price has a lateral movement, it is possible that this is due to an increase in hedging operations, in anticipation that the lateral movement will turn downward.

Some investors depend on automatic versions of the technical analysis (programme-trading and computer-trading). When the investors believe that the identification of a certain profile indicates the advisability of buying or selling, they send

simultaneous orders for the same operation to their brokers. To the extent that many investors follow these methods, technical analysis is transformed into a self-fulfilled prophecy. Prices rise or fall because many investors believe in their ability to predict and they act accordingly, producing a stream of purchase or sale orders, although not necessarily because the system has a real capacity to predict.

Technical analysis is a market-investment focus based on information concerning past prices, transaction volumes, open positions and any other information available. To the extent that this focus is useful for acting in the market, it means that the weak form of market efficiency is not being fulfilled, implying that, in an efficient market, it is not possible to make profits on the basis of past information.

c) Fundamental analysis

In accordance with the focus of analysing the fundamentals, market agents have in mind a model of the way in which supply and demand affect prices, and also of the way in which supply and demand, in turn, are affected by production capacities and economic conditions, among other factors. Agents make judgements concerning the most probable tendencies of all these factors and form an opinion concerning the direction in which price is likely to move.

To the extent that many agents incorporate all this information in their decisions, the effect of changes in fundamental variables is advanced. In an extreme case, with absolutely rational expectations, the price incorporates any information immediately.

In some markets, the fundamental variables existing there are very important. In these, typically the case for those of agricultural and animal products, the price that balances production and consumption in the long run is an "anchor" toward which the price tends to return.

In other markets, expectations concerning the future of the fundamental variables, or even the future price movement, are the predominant elements. In these markets, typically those for precious metals, existing inventories are much more important than the reaction that production and consumption may register in response to the price movement, the anchor having little influence.

Base metals are in an intermediate position, possibly closer to the precious metals than to the agricultural products. In them, the speculative strategies based on the fundamental analysis have a sufficiently long-term rationality for the anchor effect to manifest itself. High uncertainty concerning the duration of tendencies and cycles in the raw-materials markets and the high

financial costs involved in medium and long-term positions has the result that few agents take very long-term positions based on the fundamental analysis. This contributes to preventing medium and long-term expectations of production and consumption from having much influence on prices; in other words, to proving that the predictions of "rational expectations" do not occur.

2. Criticism of speculation

Speculation as a cause of the lack of representativity of the exchanges has various versions. In its most extreme version, the exchanges are seen as institutions where the transaction of "papers" generates prices arbitrated by a small number of interested persons for the purpose of achieving speculative gains and maintaining a price relationship that is favourable to consumers in the developed countries, to the detriment of producers in the developing countries.

Although this vision still persists to some degree in the developing countries, the greater incidence of the exchanges in commodities trade, and better knowledge concerning them, has caused that view to give way to less-extreme versions. The latter accept that the presence of speculators --mainly not connected with the industries-- is necessary for the functioning of a futures market; however, they point out that the present influence of speculation is excessive and would distort prices.

The excessive presence of speculators, it is argued, would weaken the relation of the exchange with the physical market. To the extent that the transaction of "papers" (futures contracts) would predominate in them, the cash price would be based on a reduced number of transactions and the functions of the exchanges as sources of physical supply or destination would be only nominal. This function would, moreover, be reduced because the futures contracts would not adequately reflect the products' characteristics.

Evidence of the excessive weight of speculation would be the high volume of contracts transacted in comparison with the volume of world production and/or the volume of physical receipts or deliveries.

The price distortion would have the result that speculators --especially institutional ones-- would not base their decisions to purchase and sell futures on the fundamental factors but rather on the so-called "technical" factors (prices, volume of open positions, and volume of transactions). In basing themselves on technical factors, the speculators would produce price movements that in many cases would cancel out the tendency supported by the fundamental factors. The distortive effect would have increased in recent decades, due to the greater incidence of institutional

speculators, especially the commodity funds. The main causes of the commodity funds' distortive effect would be the concentration of enormous volumes of contracts and the utilization of operative systems programmed to react automatically to changes in the technical factors. The waves of product purchase or sale from this reaction would exaggerate price fluctuations not correlated with market fundamentals and, in addition, would increase volatility.

A last order of criticism with respect to speculation points to the existence of information that is accessible to only some participants in the market. It specifically mentions that operators on the exchanges (brokers, commission houses, commodity funds) would have access to information on the situation of the market that would allow them to obtain benefits not possible for the rest of the participants.

3. Standards of comparison

The representativity of the price is a concept related to the standard of comparison. In order to clarify precisely the scope of the representativity criticism, it is necessary to define the standard with respect to which this criticism is effected. Usually two standards or references come to mind. One is the total supply and demand; this definition includes, in addition to production and consumption, the supply and demand of inventories, not only on the part of producers and consumers, but also of speculators not directly linked to the industry. In addition, it includes futures transactions, which are in turn influenced by what happens in other markets. This is so because the speculators make their decisions comparing the risk and return that are offered by various instruments, among them metals and their futures contracts. This reference is eminently a short-term one.

With respect to this standard, the cash price on the metals exchange is obviously always representative.

The second standard is the equilibrium price that balances "normal" production and consumption, that is to say, the levels reached once the adjustments produced as a response to temporary disturbances have come to an end. This equilibrium level is a long-term one and varies under the impact of changes of a permanent nature.

For these speculators, the first reference is the valid one, the price of the exchanges, which reflects all the information of the moment. On the other hand, for industry the valid reference is the long-term equilibrium price. Consequently, the representativity criticism comes usually from industry, which indicates that the price of the exchanges is distant from the long-term equilibrium price, and therefore gives erroneous signals for production and consumption decisions.

In assaying the representativity of the price with respect to the fundamentals, the industry is implicitly considering a long-term model that relates the price to the fundamentals of production consumption and "normal" demand for inventories of industrial agents, and possibly to other variables that affect the preceding ones.

This model shows the price that would balance production and consumption, given the technical conditions of the industry, as well as the changes that it is anticipated will occur in such conditions. However there is no model that is unique and universally accepted. Thus, whereas for some producers the price is representative, for others it may not be.

4. Examination of the effects of speculation

The analysis in this section is focused on the effects that the excessive transaction of paper has on the representativity of prices. It deals with the effect of speculation in terms of incorporating expectations of new agents in price determination, and the stabilizing and destabilizing effect on prices that this implies. Finally it presents evidence in the metals markets. In the following section, other effects of speculation are discussed.

The action of speculators generates a volume of transactions of papers that represents several times over the total production of the year, and many more times the physical deliveries through the exchanges. Critics point out that this high volume of speculative transactions in papers would be fixing a price that is not very representative. It is of interest then to explain why so many papers are transacted and what their influence is on the price of the metal. The role of the exchanges has been evolving from markets for immediate delivery to those of deferred delivery, or forward markets, and then toward futures markets. Consequently, the present role of the metals exchanges, as well as that of other exchanges, is mainly one of permitting transactions relating to price risk, and not that of solving physical supply.

Management of the price risk takes place through futures contracts. In hedging operations, sales of futures contracts tend to predominate over those for purchases (short hedging). In order to accommodate this sales surplus, it is necessary that some speculators be disposed to take the price risk of a futures contract. In conclusion, speculation in futures contracts is necessary in order that price hedging may play its role.

The volume of transactions of futures contracts, both for hedging and for speculation, has increased enormously in recent years.

a) Speculation and expectations

The growth of the volume of transactions resulted in the incorporation of new information in price formation. In reality, the transition from producers prices to exchange prices meant the incorporation of speculators' expectations, which previously did not have any great influence on price formation. By now, these have come to weigh more than producers' expectations in the determination of long-term equilibrium prices.

In markets where producers prices predominated, these incorporated only the expectations of producers. The prices changed infrequently, when evidence had accumulated concerning a situation of disequilibrium between production and consumption in the medium, or long, run. The perspective of producers tends to be one of longer-range vision (Díaz-Alejandro, 1979).

Another effect of the increase in the paper transaction is that of bringing closer, or distancing, the price with respect to its fundamentals. Theory says that speculation can have a stabilizing or destabilizing effect on the price, depending on market characteristics (Ackley, 1983). The predominant effect depends on the relative importance of production and consumption flows with respect to stocks.

b) Stabilizing effect of speculation

The stabilizing effect of speculation is seen more clearly in the case of seasonal production that can be stored. The production of an entire year can be made available in a relatively short period. If it were not possible to maintain inventories, the market price during harvest time would fall drastically in order to ensure that the entire harvest be consumed immediately. During the rest of the year the price would have to rise sufficiently in order to reduce consumption to the small quantity produced in greenhouses. But if storage is possible, then during harvest time the price will go down only sufficiently to promote an accumulation of inventories.

Markets for commodities vary enormously with respect to the degree in which speculation, and its effect on inventories, are able to stabilize prices. Markets in which inventory maintenance is impossible, as in the case of fresh flowers, are at one extreme and their aleatory fluctuations in production or demand are reflected totally in the prices of the moment. There are no inventories that can complement a production deficit, nor is it possible to accumulate inventories in order to obtain profits, even though a higher price than the present one may be expected for the future.

Non-perishable products are at the opposite extreme. If storage costs are relatively low, as in the case of metals,

inventories can reach amounts equivalent to the production of various months, or years. These inventories permit price-stabilizing, speculative actions in response to aleatory fluctuations of production or consumption.

c) Destabilizing effects

However, the existence of large inventories introduces the possibility of "speculative bubbles". The case of gold (seen as a commodity and not as money) is an extreme one, because its inventories are very large in comparison with industrial production and consumption of gold in a given year. Therefore variations in the price of gold, while affecting production and consumption over the period when they occur, have very little effect on total availability of gold. Thus the market price of gold depends mainly on the disposition of people to maintain, at that price, the existing immense inventory. This means that the present price of gold depends mainly on expectations concerning its price in the future, although a change in these expectations does not have any great incidence in the level of inventories. Therefore, although a long-term price that would bring into balance industrial production and consumption of gold is conceivable, its effect for correcting the present price by acting on production, consumption and inventories is very little. Thus expectations concerning the future price predominate over the present price; and these expectations, in turn, depend on price expectations for the more distant future.

On the other hand, in markets where production and consumption react significantly to price variations (which may have been caused by aleatory disturbances in supply and demand), and available inventories are not too high in relation to changes induced in production and consumption, the price tends to return to the long-term equilibrium position in a relatively short period of time. Moreover, this response can be anticipated by participants in the market. However, since a stabilizing response is not produced in the case of gold, speculators do not anticipate it, with the result that price expectations dominate not only in the short term but also in longer ones.

d) Speculation in the metals markets

In the metals markets, there is a stabilizing production and consumption response of the type described, but participants in the market do not fully anticipate it. This is due to the fact that there is a preponderance of speculators, who have expectations based on the extrapolation of tendencies, instead of expectations based on a market model that incorporates the concept of long-term equilibrium.

Consequently, the effective price moves towards its long-term equilibrium through the corrective response of production and consumption. But occasionally a cumulative impulse in any direction develops, which easily can exceed the long-term equilibrium level, since the extrapolation, starting with disturbances of any origin, causes later movements, in the same direction, which are destabilizing.

The speculators that predominate in the metals markets are the commodity funds. These funds act only on the basis of the evolution of three indicators: prices, transaction volumes and volumes of open positions (open interest) (CRU, 1985). Consequently, they are not concerned with forming their own expectations regarding the fundamentals in the future. On the contrary, they act on the basis of expectations of other agents, as revealed in the three indicators mentioned. If prices respond to the new information with a certain lag, this permits them to obtain benefits by operating in the adjustment period, during which the price tends to repeat known adjustment profiles. The recognition of these profiles is called "technical analysis".

Acting in accordance with the rules of "technical analysis" makes it possible to anticipate and accelerate the action of corrective influences that bring the price back in the direction of long-term equilibrium. However, if the corrective forces exaggerate their effect, it is possible for the price to surpass the long-term equilibrium level.19/

In order to corroborate this hypothesis, in the case of copper, a study of the Commodities Research Unit, Limited (United States) (1985) uses an econometric model of the market in order to explain the past movements of the price. By adding variables that represent the level of speculative activity (the volume of long and short open positions of speculators), a significant improvement in the explicative capacity of the model is obtained.

In conclusion, the criticism indicating that the transaction of papers on occasion distances the long-term price of the fundamental is valid, in the sense that speculation, while following the fundamentals, can exaggerate their effect, surpassing the long-term equilibrium level. Likewise valid is the criticism which indicates that short-term expectations come to predominate over expectations of producers regarding the long-term equilibrium price, which guided the formation of the producers price, and that, therefore, the short-term price on the exchanges is not necessarily the adequate signal for making decisions regarding long-term production and consumption.

5. Other problems of representativity

The analysis here will cover other problems that relate speculation to representativity of exchange prices: the fact that only a few physical transactions fix the price on the exchanges; the use by some agents of information not accessible to the others; and the accusations of price manipulation.

a) Low volume of physical transactions

Another aspect of the large amount of paper transactions that take place on the exchanges is that only a very small fraction of physical supply passes through them, although these transactions are those which fix the price for all production.

This is the characteristic of the auction markets. The price there for all units, over a particular period, is determined by the last unit transacted. This corresponds to the text-book, market model, where the price is determined by the intersection of the supply and demand curves. The model is called the "auction market" because it represents the result that would obtain if suppliers and buyers would participate in an auction game in order to discover the equilibrium price. The transactions realized during the game are annulled and all take place at the final equilibrium price (Walras, Eléments d'Economie Politique Pure, 1874-77).

The exchanges are one of the closest real approximations to the ideal market model of the text book. They are only an approximation because the transactions on the exchange take place at different prices during the period of transaction, arriving at a final price for the day, which is taken as the equilibrium price (unless, as will be seen later, an attempt at manipulation is detected). This quotation is the settlement price, which prevails in most physical contracts between producers and consumers.20/

Consequently, only a small number of transactions are expressed on the exchange, those that permit finding the equilibrium price for the whole market. A large majority of the physical transactions take place in reality at the settlement price, outside the exchange.

Strictly speaking, the settlement price is nothing more than the final price of a ring or of the day, but it is the closest thing to an equilibrium price. In reality, what occurs during the process of discovering the equilibrium price brings new information to the market, that modifies the equilibrium which it is sought to discover. Consequently, even if the duration of the ring should be prolonged, this would not necessarily result in convergence toward a single price, since the equilibrium is continually changing.

The fact that, on the metals exchanges, only a small fraction of physical goods are transacted, sufficient for the process of discovering the price, represents an important difference in comparison with the stock exchanges, where transactions of stocks and futures contracts have similar importance, although shares are also traded outside the exchanges. The difference is due to the fact that the shares are financial assets, that are not subject to transport and storage costs, and are of assured homogeneity. For metals and other commodities, direct contact and shipment of producer to consumer is more convenient.

b) Use of information not accessible

The exchanges are criticized because some agents would have private information, not available to others, on the basis of which they would make profits at the expense of other participants. This hypothesis is difficult to prove, although the potential for it to occur does exist. The floor brokers tend to handle purchase and sale orders of third parties which, when accumulated, have a foreseeable effect on prices. With this information, they could take positions for their own account, in order to take advantage of the foreseeable impact of executing orders in portfolio.

An investigation of the Commodities Futures Trading Commission, in the United States, concluded that there was not sufficient evidence of the occurrence of insider trading, i.e., illegal use of private information (CFTC, 1984).

c) Manipulation

Critics frequently confuse speculation with attempts to manipulate the exchanges. In reality this has to do with two different problems, since the aim of manipulation is precisely to create, and try to maintain, an artificial price with respect to market variables. In the case of manipulation, critics would point mainly to weaknesses in regulation and control of the exchanges that would permit mounting such operations.

There are various ways of manipulating a market. A classic form is that a participant accumulates all the positions for a certain delivery date and becomes the only seller on that date. This operation is known as "squeeze" or "corner" and has been frequent in the history of the LME. One of the most celebrated corners in recent times was that of the Hunt Brothers in the COMEX silver market.

Price stabilization agreements which contemplate intervening on the exchanges, as was done until 1985 under the International Tin Agreement, likewise are a form of manipulation, although their objectives are different from those of the corners. The

Inter-governmental Council of Copper Exporting Countries has agreed, on various occasions, to a policy of "limited participation on the exchanges", the aim of which is to counteract speculative bubbles through purchases on a small scale but concentrated in time. At least CODELCO, among the member-country firms of CIPEC, has realized some of these operations. Their success has been measured more in terms of the operation's profits than those of its effect on prices.

B. CONTRACTS AND PRICE REPRESENTATIVITY

The relation between the characteristics of futures contracts and the representativity of their prices is expressed in two problems:

- concordance: the measure in which a futures contract reflects the product's characteristics and those of the physical market that originated it; and

- fit: how well-adjusted does the futures contract permit the fit to be, between the physical transactions and their hedgings on the exchanges.

1. Concordance between exchange contracts and the physical market

The first problem has, in turn, two main dimensions:

- the quality or "grade", which indicates the physical and chemical characteristics of the product that are acceptable for delivery against the futures contract; and

- the location of the warehouses of the exchanges.

Critics frequently point out that the specifications of the futures contracts would be too broad, or out-of-phase in relation to technological changes that have taken place in the metals industry and its products. With respect to location, it is pointed out, for example, that warehouses exist in places of little importance for the physical metals trade and that they are non-existent in other places that are important.

Among the negative effects of the inadequate reflection of the metals markets on the exchanges, the following may be mentioned:

- the function of the terminal market, or that "of last recourse", would be realized only partially. To the extent that the futures contract contemplates too wide a range of qualities for a metal, exchange inventories will tend, preferentially, to be constituted by inferior qualities.

Therefore, a consumer who wishes to procure his supplies from the warehouses of the exchange will have difficulty finding the metal in the quality that he needs, or will have to pay a premium for it. In the same way, a producer will avoid making deliveries to the exchange if his metal of better quality is not well represented by the price on the exchange.

Another related problem is the non-existence of warehouses in important producing and consuming centres, especially in developing countries:

- contracts and warehouses that are not very representative would favour price distortion. This would occur when inventories of a metal of inferior quality would accumulate or be located in a place where no user requires them. The existence of these inventories, without incidence on the physical market, would indeed depress the exchange; and

- the compensatory premiums resulting from the lack of representativity of the contracts would make the physical trade difficult, and are resisted mainly by semimanufacturers who have difficulty in passing the premiums on to their purchasers.

2. Problems of hedgings' fit

The second type of problems, very much related to the first, refers to the measure in which the exchanges permit hedgings to fit with the physical transactions. In this connection, the following criticisms are mentioned:

- the existence of premiums that cannot be covered, as in cases where they are very high, in relation to the price of the product, and variable in the short run;

- the absence of warehouses, that would prevent the cancellation of a position with a physical delivery, and vice versa;

- the low liquidity of some contracts, or of certain expiration dates, which would not permit fitting hedgings in some periods, or only in exchange for large spreads between the purchase and sale price; and

- the limited possibility of hedging for long periods of time, either because futures contracts do not exist for those dates or due to their low liquidity. The currency in which some futures contracts are quoted makes it obligatory to simultaneously arrange currency coverage. Users in the dollar area frequently level this criticism at LME contracts

that are still transacted in pounds sterling (copper and lead).

3. Examination of the contracts' characteristics

The analysis of the characteristics of futures contracts for metals, and their effects on price representativity, must consider a very relevant factor: this is the necessary equilibrium between the liquidity of a futures contract and its faithfulness in representing the physical product which originated it. The degree of liquidity of a contract depends, in large measure, on the speculative interest it can attract. A contract with specifications that are too strict, and that therefore restricts to a relatively small universe the qualities acceptable on the exchange as good delivery, may in fact be very attractive for producers and consumers. For speculators, however, the contract will not be so attractive because inventories will tend to be smaller and more susceptible to management by the industry. The same reasoning is relevant for analysing the significance of futures-contract restrictions with respect to acceptable delivery points.

The attraction of speculators will imply a certain relaxation in the representativity of the futures contracts, which must be compensated for by the necessary liquidity, so that the exchanges may fulfil adequately their primary role in the transfer of risks.

Evidence shows that in the metals exchanges it is possible to find different cases where futures contracts have effectively departed from the characteristics of the physical markets. A classic example is the case of copper in the LME at the beginning of the 1980s. The maintenance, on the part of the exchange, of the wirebars contract (used as a reference price in the refined copper market), in spite of the fact that in the physical market this product had been replaced by high-quality cathodes (which did not have an adequate contract on the LME), generated situations that caused distortions in the quotations.

For example, the gradual decline in demand for wirebars resulted in an increase in inventories of this product on the exchange, thus depressing the price. At the same time, however, there could be a shortage in the market for high-quality cathodes, without this being totally reflected in the price for wirebars on the exchange. This situation induced producers to introduce premiums on the wirebars quotation, which were resisted by the consumers.

On the contrary, in periods of oversupply the inventories of high-quality cathodes could not be delivered to the exchange, and their owners had to sell them in the physical market at large discounts. With discounts continuing for long periods, producers faced strong pressures for renegotiating the conditions of their

physical-supply contracts (CODELCO, 1980 and the Chilean Copper Commission --COCHILCO-- 1980). Problems such as that just described, among others, impede the fit of physical transactions with their hedging on the exchange. A case that is frequently mentioned by the copper industry in the United States is the lack of liquidity of COMEX's futures contracts for certain months. In fact, it is customary for speculative activity in COMEX to be concentrated only in the months of March, May, July, September and December (the so-called "nearby months").

This means that a semi-manufacturer who wishes to hedge a sale during the month of April will not find sufficient liquidity to arrange hedging at a representative price. His alternative is to hedge with expiration in the preceding month and then move his position to the month that interests him (carry over), or else effect the hedging at a price his broker will quote, interpolating the prices of the closest active months. In the first alternative he does not totally cover the risk and in the second the price loses transparency and can be disadvantageous.

It is true also that there are no futures contracts that permit hedging over long periods. Although there nominally exist contracts in COMEX for terms of 23 months, liquidity falls abruptly beyond the period of six months. In the LME, liquidity is concentrated in the first three months, and, for some metals, at terms that are a little longer. However, this difficulty does not originate in the exchanges but rather in external factors related to risk increase. In fact, longer terms increase uncertainty concerning the levels of production that a producer who fixes prices on his future sales will in practice be able to achieve, which, in turn, limits the number of participants who will be prepared to assume the hedging risk.

C. VOLATILITY

1. Speculation as a cause of greater volatility

It has been sustained that futures markets would contribute to increasing price volatility of metals transacted thereon. In particular, it is maintained that the excessive weight of speculation would be responsible for the greater volatility. Factors cited as evidence include the greater variability of prices on the exchange, compared with those of producers, and the increase in variability in proportion to increases in speculative influence on the exchanges.

This criticism is more common among producers, who are the most affected by price volatility. At the country level, the negative effects of volatility are expressed in instability of export income from commodities. Hence the preoccupation of

governments with respect to long-term volatility. The producers of minerals and metals are concerned about the fluctuation of their profit levels and their effects on demand, since volatility discourages consumption and therefore leads to a lower rate of market growth (Strauss, 1987).

If indeed other segments of the metals industry, such as the intermediate processors and the final consumers, see themselves less affected by volatility, through being able to cover themselves or absorb the price variation, in the long run they prefer an input with more stable prices. On the other hand, given that in many cases direct contracts between producers and consumers contemplate price-fixing clauses, the price obtained usually remains below the monthly average in a magnitude related to volatility during the month.

2. Examination of the effects of the exchanges on volatility

a) Causes of the volatility

The prices of raw materials, among them the prices of metals, tend to be more volatile than those of other goods and also than the prices of financial assets. This is due to the industry's own characteristics: in part, to the fact that demand (in the case of metals) is an important source of instability since it is closely linked to the economic cycle. Moreover, variations in demand for metals exaggerate variations in consumption, because consumers also vary their inventory levels with the economic cycle, sometimes abruptly.

Fluctuations of demand are compounded by unforeseeable disturbances in supply, such as strikes or accidents. On the other hand, the reaction of production and consumption to changes in prices is slow, which implies long adjustment periods that are superimposed along with new disturbances. Finally, the speculators predominating in the metals markets are not of the anticipatory type, and thus tend rather to follow tendencies instead of acting on the basis of foreseeable adjustments in the market.

In conclusion, the causes of volatility have to do with world economic cycles and with incidents related to production, but volatility is transmitted and amplified through the low price elasticity of production and consumption in the short run. The behaviour of speculators likewise tends occasionally to exaggerate volatility.

An additional element is that the existence of exchanges alters the behaviour of some producers, diminishing even more price elasticity. The possibility of delivering on the exchange results

in a reduction of the urgency of regulating production according to changes in demand. Consequently, the whole effect of variations in consumption is transmitted to prices. In contrast, where a producer's price predominates, the producers themselves adjust both prices and production when they perceive that there are maladjustments in fundamental variables.

For the producer who delivers on the exchanges, when final demand falls, the possibility of financing has a stabilizing effect on his income.

b) Evidence concerning the effects of the exchanges

CRU (1985) shows that the speculators accentuate the price movements that originate in the fundamentals. Britto (1985) found that, for seasonal products, speculation diminishes fluctuation between seasons, but he could not prove any other effect of speculation on volatility.

One of the functions of the margins is to serve as a guarantee for the fulfilment of commitments contracted in the futures markets; a second objective is that of reducing price volatility caused by speculative activity, since speculation is discouraged when its cost increases. However, Hartzmark (1986) did not find any significant relation between changes in margins levels and price volatility.

Programmed systems of transactions seem to provoke an increase in volatility. For example, the systems used by the commodity funds establish price levels at which purchases are activated. The high volumes that the funds mobilize provoke a price increase which reaches new decision levels that, in turn, activate additional purchases, and so on successively. The final effect is an exaggerated increase in price. Likewise, when the price declines, "stop-loss" orders are activated which, as a large number of contracts are liquidated, amplify the price fall.

Comparison of annual prices

From the simple comparison of the annual averages of exchange prices with those of producers, it can be observed that when the former are very high the latter do not reach these heights, or else delay more in reaching them. The same thing occurs with respect to very low exchange prices (see annual price tables in chapter II).

The second effect that is notorious is that the gap between producers prices and those on the exchanges tends to be ever narrower and to show greater volatility.

The third effect is that, over time, instability has increased in producers prices as well as those of the exchanges. This is especially clear for prices of lead and tin, and for the rest this tendency appears to be interrupted by periods of low, relatively-stable prices at the beginning of the 1980s.

Comparison of coefficients of variation

A partial indicator of the effect of the exchanges on price volatility is the comparison of the coefficients of variation for exchange prices and producers prices. The coefficient of variation, which is the quotient between the standard deviation and the average for the period, denotes the relative variability of the price.

This comparison has various limitations which it is necessary to clarify. In the first place, the producers prices are a known reference, but transactions take place with premiums and discounts with respect to this reference, in accordance with the market situation. Producers have, at various times, preferred not to modify the producers price, but rather the premium or the discount. In other cases, transactions involve a mixture of exchange or traders prices with the producers price. Finally the producers price, on occasion, represents an average of different list prices of various producers. In general, there is no register of the premiums and discounts related to the producers price. When these are not included, the real variability of the final transaction price is being under-estimated.

The values of the coefficients of variation tend, in general, to confirm the observation that volatility is greater in periods of high prices. This is also shown by comparisons between average monthly prices and annual averages, with greater dispersion of the former in relation to the latter during periods of high prices than in those of low prices. This is particularly notorious for copper, and also tin, aluminum and lead (see figures in annex IV.2).

In comparing these exchange prices and those of producers, it is noted that the coefficients of variation for copper, tin and zinc have moved together between 1973 and 1988. The coefficients of variation of the producers price for copper were somewhat lower than those of the prices of the LME and the COMEX until 1978, year when the producers price lost all independence with respect to those of the exchanges. For zinc also the coefficient of variation was somewhat lower for the producers prices.

On the other hand, for aluminum and nickel, metals only recently having an LME price, the coefficient of variation for this price is much higher than that of the producers price. The case of lead is the only one that shows greater variability for the producers price over several years.

This behaviour tends to confirm that when the producers price has certain independence it has less variability.

At the level of annual coefficients of variation, no common tendencies among the different metals are detected for the period 1973 to 1988. But at the level of averages for the decades between 1950 and 1988 a certain common tendency is noted in that, after falling in the 1960s, the coefficients of variation of producers prices tended to rise in the decade of the 1970s, reflecting common influences originating in the world economic environment (see figures and table in annex IV.2).

D. ACCESS DIFFICULTIES

Criticisms concerning difficulties for acceding to the metals exchanges refer, on the one hand, to obstacles for operating in them and, on the other, to restrictions that prevent greater influence and participation of the metals industries.

1. Obstacles for operating in the exchanges

The principal criticism regarding obstacles to operating comes from the developing countries and refers to the difficulties that users of these countries would have in order to absorb the costs of operating in the exchanges. The central point is the margin system, which imposes the following limitations:

- the availability of financial resources sufficient to cover this requirement and, in the case of the developing countries, foreign exchange;

- the high degree of uncertainty concerning the volume of funds that must be allocated for this purpose; and

- the coincidence of margin requests with adverse movements in the price of coverage.

The interaction of these limitations can be illustrated with an example. A State lead producer considered it advisable to fix the price of part of his production, selling futures contracts in the LME. After the sale, the price of lead continued to rise and the producer had to cover the variation margin between his sale price and the actual price. This coverage, which a posteriori resulted inconvenient, obliged the firm to transfer foreign exchange abroad. If a firm does not have the funds, it can even be forced to liquidate its position on the exchange at a loss.

Other obstacles mentioned by the critics refer to the difficulties between the fit of the physical metals trade and its hedging on the exchanges.

2. Restrictions for participating

The criticisms refer to two related aspects: the requirements to be a member of the metals exchanges, and the restrictions for achieving a greater degree of influence in the management of the exchanges on the part of the metals industry.

Regarding the first of these, it is stated that the requisites demanded of companies that desire to be members of the LME or the COMEX are not accessible for firms of developing countries.

The second aspect is the criticism of the lack of participation of industries in the direction of the exchanges and the scant attention that demands of industry would receive in them. It is argued that the administration of the metals exchanges expresses the interests of those intermediaries who are most desirous of attracting volume through speculation rather than serving the hedging needs of industries. This results in the maintenance of futures contracts that are little representative and prejudicial for the metals trade. On the other hand, the exchanges would not maintain sufficiently strict control over operations, favouring occasional manipulatory practices.

3. Examination of access difficulties

a) Obstacles to operating: margins

There is no doubt that the transfer of important foreign exchange sums in order to cover margins, together with uncertainty concerning when, and in what quantity, these funds will be required, imposes an important restriction on the participation of firms of developing countries, especially the smaller ones. In this sense, the complaint registered is justified, even though the exchanges tend to request smaller margins for hedging operations than for speculative ones.

However, the problem is considerably more complex, to the extent that the margins system is indispensable for the exchanges' operation, while simultaneously protecting the interest of all participants. In reality, if this system would not exist, there would be an increase in risk, and situations of insolvency could be generated that would affect the different users, as well as the exchange itself.

The recent experience of the LME is particularly relevant for illustrating the inevitability of the system. The collapse of the tin market, facilitated by the fact that margins were at the discretion of the broker, brought about the restructuring of the LME, with the establishment of more objective and stricter rules. Apart from this, the margins requirement affects potential users of the developing countries in an unequal way. The large producing firms, whether public or private, have less difficulty dealing with margins. On the one hand, they have a larger flow of their own funds, and, in addition, they have better access to bank financing for their operations in futures markets. However, the existence of limits to indebtedness at the country level can make it difficult for a firm to have access to external financing that would otherwise be available to it.

Margins do constitute an important obstacle for potential users from countries of smaller size, typically the small and medium-size mineral producers in Latin America.

There are, however, operating alternatives that permit reducing the effect of the margins system. A common form is that metals traders who buy from a producer, grant, as part of the sale contract for the metal, possibilities for fixing the price without additional cost. In practice, this allows the producer to cover himself against the price risk without recurring to the exchange.

Another example is that of some public mineral processing and trading firms that offer similar facilities. An interesting case is that of ENAMI in Chile, which offers price hedging possibilities to small and medium-size miners of copper, gold and silver, absorbing the margins in exchange for a commission. The use of options likewise can diminish the obstacle represented by the margins. Although operating in margins implies paying the cost of the premium at the beginning of the operation, it establishes a known limit on the amount of resources that will be employed, which does not vary over time.

It should also be mentioned that there are ways of granting greater flexibility in margin coverage. For example, in the COMEX, certain financial assets are accepted for covering the initial margins.21/ In the LME it is possible to cover a certain proportion of initial margins and those of variations with letters of credit or bank guarantees, and with warrants. In the COMEX, as well as in the LME, brokers grant credit lines to their important customers in order to cover part of the margins.

The limits of the daily price movements on the exchanges serve a purpose similar to that of the margins. Therefore, the existence of limits implies smaller margins than those that would be required if prices did not have daily limits. These tend to exist in markets for agricultural and animal products, but are less usual in metals markets.22/

b) Internal obstacles

While recognizing the inhibiting effect that the margins system has on greater participation of the developing countries in the metals markets, evidence points to other causes of equal importance in the internal sphere of the developing countries. The most important cause is the prejudice existing within the developing countries concerning the true nature of the exchanges and their potential benefit. The vision of the exchanges as "black boxes" that only the initiated can understand, and the operation of which is unfavourable to the developing countries, is no less frequent for being exaggerated. It is true that this extreme vision has given way to other more realistic ones; however, its persistence over a long period of time, and the existence of sectors within developing countries that still sustain it, determine the prevailing scarcity of knowledge concerning the exchanges.

Ignorance of the exchanges has as a result the following problems. At the country level, there is a tendency to prohibit or restrict futures markets operations of national firms, in order to avoid capital flight or the diminishing of export returns through the effects of adverse hedgings.

These policies ignore the fact that in essence a hedging operation implies that any loss on the exchange is compensated in the physical market and vice versa. The problem, therefore, is reduced to one of adequate control over operations on the part of the authority, in order to avoid speculative positions, and to ensure that foreign exchange transfers correspond to exchange positions. This control requires adequate knowledge of the operating system of the exchanges on the part of the authority, usually the Central Bank.

Lack of knowledge concerning the exchanges can be an obstacle to their utilization at the level of the firm, even in cases where the operation on exchanges is authorized and regulated. In the case of State producers, there is a classical problem that arises through the a posteriori judgements of adverse price hedging results, a problem that is aggravated by the impact of margins. In addition, firms have difficulty in assimilating the changes in accounting practices that are required for incorporating exchange transactions.

Still another dimension of backwardness is the lack of operative experience in exchanges on the part of the developing countries. This lack of experience restricts the ability to take more complete and more beneficial advantage of them. Even when it may be desirable to have a gradual process of apprenticeship in order to avoid erroneous decisions due to inexperience, there is evidently a lack, in the developing countries, of elements that could give initial support to futures operations. On the other

hand, the alternative of contracting experienced personnel abroad is expensive.

c) Institutional participation

The institutional participation of the metals industries in the exchanges has a natural limitation. Institutionally, the exchanges must reconcile the interests of the different participants and, therefore, the metals industries cannot pretend to exercise hegemony in them.

Although it is not possible to say that, in the metals exchanges, there is discrimination with respect to the participation of industries, it is also true that the direction of the exchanges is exercised fundamentally by the brokers who are mostly the owners of the companies that operate the exchanges. In the case of the LME, it is specifically the ring dealers who have effective control over decisions.

The industry, however, can participate and exert influence, not only through subsidiary firms that are members of the exchanges, but also by acting on the various ad hoc committees that the LME, as well as the COMEX, maintain for discussing matters of special interest to users of the trade. Moreover, the LME has recently broadened representativity of the industry in its Board of Directors, by incorporating four executives of metals-producing and processing firms.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. Tendencies in the metals markets

a) Greater interdependence

The financial environment in which the metals exchanges operate has undergone great changes in the last two decades. Until sometime ago, the exchanges were primarily reflecting the interests of metals industries and speculators specialized in metals futures. Moreover, producers prices were the main reference. Since then the financial markets have developed enormously, as well as the interdependence among them. The volume of transactions in the exchanges themselves has increased exponentially, through the operations of investors who move from one market to another, looking for new profiles of expected returns, and for whom the metals exchanges are just one more financial market (see chapter I, section B).

This is a condition that is not likely to be reversed. In the measure that many buyers and sellers continue to participate in the metals markets and that their prices continue to be subject to great uncertainty, the exchanges will continue to attract not only the industry --in order to hedge its risks--, but also speculators --in order to gamble on price movements.

b) Weakening of producers prices

Even in those metals where production is concentrated in a few producers, such as nickel, prices on the exchange have gradually replaced producers prices. The list prices of producers continue to exist in various industries, but their significance is much less than in the past. They are very frequently adjusted to quotations of the exchanges, either through changing their level or through premiums or discounts, often unpublished. Consequently, differences from market prices that occasionally appear are not effective (see chapter II).

The possibility cannot be discarded that, in some particular metals industry among those that are analysed in the study, for various reasons, supply might be concentrated in a few producers. Such a possibility would create conditions for establishing an effective producers price, although probably it would be difficult to displace an exchange price that has already become dominant.

The existence of a group of competitors in the margin makes it difficult to maintain an effective producers price. Great productive discipline is required on the part of the leaders among the producers, in order that the administered price not differ substantially from the market price. Should this occur, consumers would have difficulty in maintaining their loyalty to their habitual suppliers. Since the processors add little value to the raw materials, which are expensive, the price differences can easily become much greater than their profit margins.

The case of tin shows that the resources which are necessary in order to maintain a price, without following a productive discipline, escalate out of control.

c) Growing utilization of the exchanges

Increasingly producers have changed to references determined on the exchanges. However, the use of the exchanges for other purposes, such as risk hedging, has been more gradual over time and is still very insufficient in Latin America and the Caribbean, as well as in developing countries in general. Only some producer-firms follow permanent policies for hedging or take advantage of the exchanges in order to lock the spread, or to finance inventories (see chapter II, section C). There is still ample scope for taking advantage of the benefits of the exchanges. Assuming that these institutions are here to stay, with their advantages and disadvantages, it is better to enjoy the advantages than to suffer only the disadvantages.

2. Price problems of the exchanges

a) Representativity and volatility of the exchanges Speculation and price instability

Speculation in futures contracts is necessary if price hedging is to play its role. The transition from producers prices to exchange prices meant the incorporation of speculators' expectations into the reference prices used by industry. Previously these expectations had no great incidence in prices used in the trade; however they have by now come to have more weight than those that producers nurture concerning the long-term equilibrium price.

Consequently, the metals price can be far from the long-term equilibrium level for prolonged periods. It is entirely true then that the short-term exchange price is not necessarily an adequate signal for taking longer-term decisions concerning production and consumption.

This is due to the fact that production and consumption respond to price changes, causing prices to converge toward that equilibrium, but in a slow way, price elasticities being low in the short run. Speculators could foresee that stabilizing reaction of production and consumption, advancing its effect on prices, which, consequently, would converge more rapidly.

This behaviour occurs in the agricultural markets, generating a certain degree of price stabilization between one harvest and another. To a certain extent it is also found in the metals markets. But stabilizing speculation is discouraged by two factors. One is the long time that correction of the fundamentals takes. Another is the highly probable occurrence, in the meantime, of new disturbances in the fundamentals, which would again distance the price from its path of convergence toward long-term equilibrium.

These two facts have the result that, while speculators adequately foresee the forces toward which the fundamentals will push the price, this information must be discounted strongly, with regard to both time and risk. Consequently, there tends to be a predominance of speculators who extrapolate tendencies instead of acting with expectations based on a market model that incorporates the long-term equilibrium concept. The extrapolation of tendencies tends to accentuate movements in the same direction in which the market had been moving previously, thus destabilizing it (see chapter IV, section A).

Importance of physical transactions

The fact that the metals exchanges are used to transact only a small fraction of annual production, is due to the saving of the cost of transport and storage for taking the material to the exchange, and to the convenience of the direct contract between producer and consumer. This does not make any less efficient the process of "discovering" the exchange price. It is enough that a major proportion of physical transactions outside the exchange take place at the exchange's settlement price. In these conditions the excess of demand or supply in the same market becomes manifest in the exchange.

"Fit" between exchange contracts and the physical market

The fact that the exchange contracts do not represent the physical product that originated them, in a completely faithful

way, generates problems of "fit" that are important for members of the industry. The essential factor, however, is the need to reach a balance between the indispensable liquidity of a future contract, and its closeness to the product's characteristics. A contract with specifications that are too rigid will restrict to a relatively small universe the qualities that are acceptable on the exchange as "good delivery"; this can be attractive for producers and consumers, but not for speculators, since inventories will be smaller and more susceptible to management by the industry (see chapter IV, section B).

Volatility of exchange prices

It is true that metals prices are very volatile, but this is due, in an important measure, to the very characteristics of these industries. In reality, the causes originating the volatility have to do with the world economic cycles and with unforeseen circumstances related to production, the effects of which are amplified by low production and consumption elasticity with respect to price.

The existence of exchanges affects the price stability of metals in the measure that the behaviour of speculators tends, occasionally, to exaggerate volatility.

In addition the behaviour of some producers is altered by the possibility of delivering on the exchange, thus diminishing still more price elasticity. There is evidence that price volatility has increased over time, along with the substitution of exchange prices for producers prices, as seen when long periods are compared (see chapter IV, section C). The evidence presented is not sufficient for demonstrating a hypothesis, but it is coherent with the following observations:

- In the measure that producers have not been able to isolate their prices from the influence of the exchange prices, they have been modifying them more frequently. As a result, the differences between the levels of the prices, as well as between their degrees of volatility, have narrowed. As metals industries have diminished their concentration and exchange prices have become more important, producers have reacted to changes in demand with less regulation of production, which has increased volatility through causing prices to support more of the adjustment and supply less of it.

- On the other hand, there seems to be a tendency over time toward greater price volatility, as a consequence of greater variability in the world economy; however, this effect is interrupted in part by a prolonged period of low prices and less volatility, in the beginning of the 1980s.

b) Restrictions on access to the exchanges

Margins

The margins system imposes an important restriction on the participation of firms of developing countries in the exchanges, not only because of their amount but also because of uncertainty concerning the moment when they will increase. In this sense, it is true that there are problems of access for smaller producers. The margins system, however, is indispensable for maintaining the interest of participants in the exchanges.

Internal obstacles

Countries tend to have internal obstacles for the participation of producers in exchange operations. Due either to lack of knowledge or prejudice, there are formal and informal prohibitions against futures markets operations by national firms. On the part of the producers of the developing countries, there is a lack of experience in operating on exchanges, which restricts their taking more complete advantage of them (see chapter IV, section D).

Institutional participation on the exchanges

There are obstacles to the institutional participation of producers on the exchanges, but it cannot be said that there is discrimination with respect to users from developing countries. Those who are in control are the brokers, for whom it is convenient to attract not only the trade but also the speculators. Recent experience on the metals exchanges shows that, while prejudicial situations have existed, and still exist, for the metals industries, the exchanges have demonstrated a capacity for evolving and considering the problems of the industry. In general, this process has been slow and the exchanges have reacted only after pressure on the part of industry has accumulated.

The process of negotiation between the exchanges and industry shows a similar cycle in each case. This starts with criticism by the industrial sectors affected and resistance of the exchanges, which are reluctant to introduce modifications that could diminish the volume of transactions in a contract. To the extent that industry is capable of amplifying the support of its criticisms, a long process of consultations has opened up which finally is permitting compromise solutions. There can be cases where industry itself is divided over a problem, which makes it difficult to find a solution that will accommodate the interests of all parties.

Recent examples of greater aperture on the metals exchanges towards requirements of industry, among others, are the requirements for being a member of the LME and the greater representativity of industry in its directorate, the introduction of a contract for high quality copper on the COMEX, the establishment of new warehouses of the LME, in Singapore and Japan and the introduction of a contract for high quality zinc in the LME (see chapters I and II).

From the preceding it may be concluded that tension on the metals exchanges exists between the interests of the industry and those of the speculators, more than between the interests of the industrialized countries and the developing countries, as frequently is believed. There are, without doubt, aspects of special interest for producers of the developing countries, in the measure that some restrictions affect more those who are smaller, have less resources, or are further away in terms of knowledge and capacity to influence. These characteristics describe well the small producers of the zone, but not the large producing and trading firms of Latin America and the Caribbean.

3. Advantages of use of the exchanges

a) Coverage of the price risk

The main advantage of participating in the futures markets is that of hedging the price risk. Hedging offers various possibilities, such as obtaining a cash price equal to the annual average of the exchange, for which it is necessary to correct imbalances through operations on exchanges.

If future prices in effect generate acceptable profitability, the hedging permits fixing it for several months in the future, thus avoiding a sacrifice of profitability in case of adverse price movements.

With hedging through futures contracts, the possibility of sharing in price increases is lost. However through the payment of a premium, options limit losses, without impeding the benefits of the increases (see chapter III, section B).

The exchanges, in addition, permit carrying out more complex commercial operations, at the same time satisfying the requirements of sellers and buyers. For example, through arbitrage operations, a copper producer can obtain the LME price, whereas the processor pays the COMEX price.

The financial institutions usually are not disposed to lend, taking all the risks characteristic of a mining project. Hedging

the price risks on the exchanges distributes them and thus facilitates financing of such projects.

b) Income stabilization

While hedging with futures contracts permits fixing prices for a certain period of time, options permit stabilizing income within a range of prices. The scheme consists of comparing options "put" with the exercise price that is equal to the lower level of the stabilization range. This purchase is financed by selling "call" options at an exercise price equal to the upper level of the stabilization range. If the upper and lower levels of the range are well selected, the scheme is self-financing.

c) Other benefits

The exchanges also offer other benefits to industry, such as financing of inventories through taking advantage of the spread, which can compensate part, or all, of the financial cost of maintaining inventories.

Finally the exchanges, in particular the LME, can be used as a physical market of last recourse for deliveries, as well as for physical supply, on the part of different segments of the metals industry.

B. RECOMMENDATIONS

1. Greater utilization of the metals exchanges

a) Improving knowledge about futures markets

The lack of knowledge, and consequent prejudice, concerning the nature and functions of the metals exchanges has been identified as one of the important obstacles for increasing its use on the part of the metals industry in the developing countries. Hence the need to increase the degree of knowledge concerning the exchanges, their functioning and the advantages and disadvantages of their use in the metals and minerals trade. This action should include initiatives at different levels:

- The large producing and processing firms in Latin America and the Caribbean in general have adequate knowledge about the exchanges and many are operating in them (see chapter II, section C). Most of the large private firms belong to transnational groups that have definite policies for operating in futures markets. On the other hand, it is more common for the State firms

to be limited in using the exchanges to a greater extent, owing to a lack of understanding concerning their advantages, which prevails at the level of government bodies that oversee their management and among officials who make up their boards of directors and their high-executive plane. Therefore, even though it is necessary to reinforce training of executives and commercial operators in the firms, it appears to be more urgent to undertake educational initiatives directed toward governmental institutions which definitively are those that authorize the operation of public firms on the exchanges. These institutions include central banks, ministries, holding companies of public firms and others, depending on the reality of each country.

- Initiatives addressed to the small and medium-sized private mineral producers are required so that these agents may understand how the use of the exchanges can improve their productive and commercial operation. At this level, it can be more effective that the processing or trading enterprises, that in various Latin American countries purchase the production of these firms, take charge of carrying out this training. If these firms have the ability to do this, the training can take place directly, or otherwise they could assume responsibility for organizing and channeling activities of third parties. An example would be the seminars and conferences that are frequently organized by the international brokers and traders themselves for these purposes.

- Another aspect of training is the case of firms that are already operating on the exchanges. In these cases what is required is the broadening of operative experience. This type of knowledge is achieved basically through practical experience. To gain this, it is useful to arrange training programmes for operators in the London or New York offices of brokers. The brokers generally offer this possibility to their clients without cost; however, for the training to be effective, it should be provided for a relatively long period (a minimum of six months to one year). Another possibility is the contracting of experts in exchange operations for short periods, in order to advise firms on action strategies in the exchanges and train operators.

b) Financing margins

A priority goal of any initiative in this sense should be the reduction of the obstacle that margins represent for better use of the exchanges. The solution is not easy, since it involves various factors, many of which have a dimension that is beyond the problematicity of the exchanges. For example, some firms that are able to finance margins cannot do so because of exchange regulations of the country where they operate, or because they are limited in their capacity for borrowing by credit restrictions imposed at the country level. This type of restriction is particularly relevant in the Latin American region and therefore

determine a macroeconomic conditioning, the possible solutions for which are outside the scope of the present study.

A proposal that traditionally has been made in order to facilitate margin financing for users of developing countries is the establishment of specific funds for this purpose, under the administration of multilateral organizations such as the World Bank or the International Monetary Fund. Another suggestion that has been made is the possible use of the "second window" of the Common Fund for Commodities of the United Nations Conference on Trade and Development (UNCTAD) (CRU, 1984). Undoubtedly this type of financing would be positive, but the feasibility of carrying out a scheme of this type in the short or medium run is scant. The difficulty stems not only from its being an initiative conditioned by a process of international negotiation that is quite complex, but also from the operative problems that would arise with a fund destined to finance activities with a high-risk level. This risk is mainly associated with the unequal experience that the developing countries have in exchange operations.

The feasibility of these proposals likewise is complicated when the purpose of operating on the exchanges is income stabilization in the long run. This implies long-term futures transactions, which increases margin requirements and prolongs the period of financing.

Taking all this into consideration, it appears to be more recommendable to concentrate efforts on more modest methods which will be more practical and more accessible for firms in developing countries:

- the public or private processing or trading firms should intermediate to permit small and medium-sized producers to have access to futures markets. Given their larger size and greater access to credit, these firms are in a better position to obtain credit lines from brokers for financing margins. This greater flexibility would permit them to extend price-hedging facilities to local suppliers, with smaller margins and the backing of the physical supply contracts with the producers. Schemes of this type have been carried out with relative success by ENAMI in Chile (see chapter III).

- indirect hedging mechanisms incorporated into purchase-sale metal contracts with traders represent another alternative. Although excessive use of this type of contract can prejudice the autonomy of a firm for fixing its trade policy, this problem is not very relevant for small-sized producers.

- the large firms which have better resources for financing margins (leaving aside the macroeconomic limitations) should take maximum advantage of flexibilities offered by brokers. For example, diversifying the number of brokers utilized in order to maximize

the effect of the credit lines that they offer to their clients (see chapter III). However, it is necessary to warn that this type of flexibilities can be diminished in the near future, as a result of new regulations in the LME (see chapter I, section C).

- an interesting alternative, not often found in developing countries, is the use of options markets. The great advantage of options, from the viewpoint of margins, is that they replace them with a fixed premium. Although there is still the need to finance the premium, it is possible to avoid the margin requirements with their variable magnitude and indefinite duration. In addition, there are schemes for operating in options that allow a producer to finance a premium by limiting to a certain level his share in future price increases (see chapter III).

2. Improvement of efficiency and access to exchanges

a) Participation of industry

In the context of the present study, the subject of the efficiency of the exchanges is dealt with in relation to the interests of the non-ferrous metals industry. Given that the line-up of dominant interests in the exchanges is between industry and the speculators and investors, it is necessary to have greater involvement of the former in order to ensure that the metals exchanges respond in greater measure to the interests of the industry.

This can be achieved through direct participation as members of the exchanges, or indirectly through different initiatives tending to influence them. These actions, however, must be taken while at the same time accepting the necessity of an adequate balance between hedging needs of the industry and the liquidity of the speculators.

The objectives of these actions depend on the reality of each industry. In addition to activities tending to make the exchange contracts reflect more faithfully the characteristics of the physical markets, it is possible to identify the following areas of common interest:

- to increase the representation of industry in the boards of directors and ad hoc committees of the exchanges.

- to increase the transparency of the exchanges through improving the quality and frequency of the statistics, particularly in the case of the LME.

- to ensure that the tendency toward greater protection of the solvency of the exchanges and their users, expressed in stricter

margin requirements, is not expressed in the form of a very large increase in operative costs.

- in the case of the LME, to regulate more precisely the operations of speculators and investors, establishing limits on speculative positions, and making reporting obligatory, for the purpose of diminishing possibilities for manipulation.

b) Regional exchanges

The establishment of regional non-ferrous metals exchanges in developing countries does not appear to be feasible. The main problem is that it would be difficult for these exchanges to generate the liquidity necessary for the market to function with a minimum of efficiency. Liquidity depends on the participation of speculators and it would be difficult to attract them to an exchange located in a country that has a little-developed financial system and exchange controls. Moreover, when these exchanges are located in countries that are important producers of a metal, external participants are likely to be concerned about the possibility of the market's being subject to administrative interventions in order to influence prices. These factors explain, for example, the scant development of the Malaysian tin exchanges as effective markets for futures.

Notes

1/ "GM Testing Purchase Policy Changes", Metal Bulletin, 8 August 1988, p. 5.

2/ The "soft" limit is an expression that originated in the international financial jargon to refer to proposals for flexible exchange rates with maximum and minimum limits.

3/ Note that this solution gives the same result with respect to price mixture as altering the composition of the INCO system in order to give greater weight to the LME price and less weight to the limits, thus diluting the advantages of the system.

4/ In 1982, the Intergovernmental Council of Copper Exporting Countries approved a resolution suggesting that trading firms of member countries put into practice "limited participation" operations in order to counteract speculative take-offs of the price with respect to market conditions.

5/ The objective of the hedging may be to cover inventory costs.

6/ The premium results from the fact that the future price at which the producer is selling is lower than the expected cash price. This premium is received by the counterpart, a speculator who buys the future contract hoping to gain the difference. On balance, that difference is proportional to the "systematic risk" of the future price. Consequently, the long hedger, the case of the producer pays a premium and those who take short positions, whether hedgers or speculators, gain a premium. This is the case when there is net long-hedging pressure in the markets. In other words, there are more agents arranging short hedgings than long hedgings, so that in order to induce speculators to take short positions, it is necessary that the speculator earn a premium for taking this risk (this theory is known as the "normal backwardation" theory). If the net pressure in the market is of short hedging, the situation is just the inverse.

7/ The commodity traders use the term "spread" to refer to the basis when the future price is higher than the spot price, and "backwardation" when the situation is the contrary.

8/ It is said that then the convergence is perfect. Often there is no perfect convergence, that is to say the basis is not at zero, only because there are technical differences (of quality or others) between a physical contract for immediate delivery and a future contract.

9/ In the literature, at times it is said that the hedging is perfect when the basis is the same at the moment of entering into the contract as at the moment of closing. In this case, the cash price that exists at the moment of opening the operation is that which is obtained for the physical operation and the exchange operation combined.

10/ A trader's "book" is his register of all his purchase and sale commitments, whether physical or in futures markets. The merchant can "fit" one commitment with another of the opposite sign

within his own book, arranging hedging that does not pass through the exchange.

11/ In October 1988, Codelco sold copper for US$20 million to Citicorp International Trading Company in these conditions. (La Epoca, 20 October 1988, p. 21.)

12/ Futures contracts are liquidated and rewritten day by day, with margins appearing for the quantity that the price moves against the operation.

13/ Another difference between a bond and a future contract is that the future price is not in reality the price of an asset, but rather the price that makes the value of a future contract be exactly zero in the moment when it is signed. The value expected of the future price may rise or fall as the moment of maturity approaches (depending on whether hedging pressure in the market is in net short or net long terms). On the contrary, the anticipated value of the price of a bond rises only as the moment of maturity approaches (unless there is an unexpected increase in the interest rate, in which case all bonds go down in price).

14/ Strictly speaking, the trader does not buy cash in gold on the exchange, but rather requests a loan in gold from commercial banks.

15/ Let us examine the investment in this combined operation and its return (or rather cost, since its return is negative).

Consider that the operation is opened in the period 0 and closed in the period 1. The initial investment is 0, since the cash gold is bought at P_0 with a loan for exactly P_0, and the sale of a future contract does not require investment nor does it generate income. In period 1, the gold is sold at P_1, it must be repaid P_0 $(1+r_d)$ for the loan and its interest; and the forward contract, for the seller, is worth (F_0-P_1). The value of the total portfolio, in period 1 is then the sum, equal to $[F_0 - P_0 (1+r_d)]$. Let us add that, by definition the future price F_0 is equal to the cash price P_0 plus the contango; or if desired, equal to the cash price P_0 by one plus the interest rate implied by the contango r_c. Then, the value of the total portfolio at the moment of expiration is $[-P_0 (r_d-r_c)]$. In other words the cost of the operation is the difference between the rate of indebtedness and the contango (in its equivalent in interest rate) for the amount of the gold purchased.

In summary, the borrowing wins the spread, the cost of indebtedness is the respective rate; and the cost of the combined transaction corresponds to the difference between both rates.

16/ The return of a combined position in gold (from its own production and from a gold loan) is: cost: the difference between the bank rate and the contango; benefit: the use of gold (in its monetized equivalent) for the period of the loan, which is prolonged for ever, since the loan is repaid with its own production.

This is equivalent to the combination of a loan and the forward sale of gold to be produced in a later period (fixing then the price in advance).

17/ This case is similar to the problem of front running in the United States exchanges, where floor brokers act in advance of orders from their customers.

18/ Shearson, Lehman, Hutton and Deak are ring dealers, Dean Witter, Merril Lynch, Paine Webber, Prudential-Bache and others are associate-broker clearing members.

19/ A possible hypothesis to explain the type of behaviour of the dominant speculators in the metals markets is that uncertainty concerning the future is very high (which results in high price volatility) for acting on the basis of expectations concerning the long-term adjustment in the market.

20/ These contracts tend to be based on an average of the settlement quotations for the month of shipment, or permit the buyer to use the settlement quotations for some days of the month, according to pre-established rules.

21/ In the COMEX, margins are pre-established and adjusted periodically.

22/ Brennan (1986) offers a rationalization of the effect of the daily price limits on the conduct of market agents. The limits protect the speculator against very large price movements against him, replacing the possibility of a catastrophe with a requirement to comply with new maintenance margins. As the price level that will prevail on the following days is not known, the speculator cannot be sure whether it is convenient for him not to fulfil his commitments or whether he will be able to recover. For products with an active spot market, future prices are good predictors of the cash price that will prevail later; consequently this uncertainty (which is an incentive for compliance) is less. For this reason, the daily price limits in the metals markets are not so relevant as in the market for agricultural or animal products, where often the spot market is not very active.

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STATISTICAL ANNEX

Table I.1

LONDON METALS EXCHANGE TRANSACTION VOLUMES: 1983-1989

(Thousands of metric tons [*])

Metals	Type	1983	1984	1985	1986	1987	1988	1989 (4)
COPPER (1)	TOTAL FUTURES	49 249	33 047	31 626	30 217	44 793	83 447	34 851
	GRADE A	38 426	32 592	31 457	29 766	44 622	83 418	34 851
	STANDARD	10 822	455	169	451	171	29	-
	OPTIONS	-	-	-	-	1 271	1 213	-
ZINC	TOTAL FUTURES	10 289	10 164	7 655	6 966	8 886	18 177	10 903
	HIGH GRADE	-	40	2 355	6 966	8 886	17 847	7 290
	STANDARD	10 289	10 124	5 300	-	-	-	-
	SHG	-	-	-	-	-	330	3 613
	OPTIONS	-	-	-	-	6	219	-
ALUMINUM	TOTAL FUTURES (2)	34 223	30 622	25 463	18 725	35 715	67 802	23 902
	HIGH GRADE	-	-	-	-	1 246	16 831	23 902
	STANDARD	-	-	-	-	34 469	50 971	-
	OPTIONS	-	-	-	-	1 103	3 380	-
TIN (3)	TOTAL FUTURES	1 347	1 309	774	-	-	-	-
	HIGH GRADE	72	216	73	-	-	-	-
	STANDARD	1 275	1 093	702	-	-	-	-
LEAD	FUTURES	11 885	13 439	8 072	7 769	9 763	12 129	4 187
	OPTIONS	-	-	-	-	6	7	-
NICKEL	FUTURES	1 755	1 552	813	759	1 324	2 062	1 100
	OPTIONS	-	-	-	-	3	3	-
SILVER (5)	TOTAL FUTURES	1 501 016	n.a.	537 160	240 054	135 948	100 228	20 562
	LARGE	1 500 480	1 328 020	536 730	240 000	135 890	100 160	20 550
	SMALL	536	n.a.	430	54	58	68	12

Source: The London Metal Exchange.

[*] Silver, in millions of troy ounces.

(1) Prior to 1986, "Grade A" copper was called "High-Grade Copper".
(2) No specific classification until 1986, only one contract.
(3) Quotation suspended in October 1985.
(4) January to April 1989.
(5) Large: silver 10, 10 000 troy ounces; small: silver 2, 2 000 troy ounces.

n.a. Not available.

Table I.2

COMEX

VOLUME OF TRANSACTIONS FOR COPPER AND ALUMINUM: 1984-1987

(Thousands of contracts and thousands of short tons)

YEARS		ALUMINUM	COPPER	COPPER OPTION
1984	Contract	82 661	2 505 365	-
	Thousands (ST)	3 306	62 659	-
1985	Contracts	77 063	2 444 552	-
	Thousands (ST)	3 083	61 114	-
1986	Contracts	52 627	1 872 209	112 949
	Thousands (ST)	2 105	46 805	2 824
1987	Contracts	8 500	2 569 178	612 850
	Thousands (ST)	340	64 229	15 321

Source: COMEX, Statistical Yearbook.

Copper: Contracts for 25 short tons.
Aluminum: Contracts for 40 short tons.
ST: Short tons.

Table I.3

COMEX

PHYSICAL DELIVERIES OF COPPER AND ALUMINUM: 1984-1987

(Volumes in thousands of contracts and thousands of short tons)

		1984	1985	1986
Aluminum	Contracts	5 883	2 918	2 573
	Thousands (ST)	235	117	103
Copper	Contracts	45 492	30 801	22 343
	Thousands (ST)	1 137	770	559

Source: COMEX, Statistical Yearbook.

Copper: Contracts for 25 short tons.
Aluminum: Contracts for 40 short tons.
ST: Short tons.

Table I.4

COMEX

MONTHLY VOLUME OF TRANSACTIONS

Months	YEARS							
	1984		1985		1986		1987	
	Aluminum	Copper	Aluminum	Copper	Aluminum	Copper	Aluminum	Copper
January	5 291	199 461	10 788	254 052	8 409	190 983	967	124 843
February	8 567	259 881	9 222	261 784	9 600	206 513	1 688	178 590
March	4 231	217 635	4 935	167 686	7 982	197 818	1 431	165 212
April	9 190	269 765	7 353	310 487	8 572	240 770	640	170 827
May	14 086	196 382	4 935	215 079	3 250	106 750	895	208 690
June	6 203	223 551	6 609	209 506	4 475	200 547	745	306 002
July	3 304	152 424	4 159	146 396	2 218	89 818	408	272 782
August	3 006	215 226	9 052	195 882	2 855	145 468	390	214 169
September	3 262	149 465	3 342	138 803	1 600	123 779	527	192 960
October	2 278	170 568	3 166	178 728	1 104	121 361	319	276 478
November	2 678	279 151	6 934	200 142	1 699	162 963	268	278 977
December	1 868	172 856	6 568	166 007	863	85 439	222	179 467

Source: COMEX, Statistical Yearbook.

Copper: Contracts for 25 short tons.
Aluminum: Contracts for 40 short tons.

Table I.5

COMEX

OPEN INTEREST FOR COPPER AND ALUMINUM

(Volume of contracts on the last day of the month)

Months	YEARS							
	1984		1985		1986		1987	
	Aluminum	Copper	Aluminum	Copper	Aluminum	Copper	Aluminum	Copper
January	3 304	107 041	4 102	94 398	2 386	89 123	828	75 844
February	3 006	100 663	3 727	82 182	2 179	79 497	722	77 526
March	3 262	107 730	2 710	82 195	2 476	91 606	985	76 775
April	2 278	96 293	2 460	85 676	1 717	73 828	883	67 052
May	2 678	92 254	2 264	82 369	1 444	71 286	754	72 441
June	1 868	82 836	1 803	84 913	1 098	65 698	661	89 640
July	3 141	82 946	1 686	78 227	1 215	62 060	542	87 353
August	3 017	84 991	1 507	75 187	869	60 118	521	64 979
September	2 974	83 606	1 749	77 106	854	65 370	554	62 572
October	4 058	88 418	1 873	75 868	948	70 396	441	49 383
November	5 269	83 433	1 687	76 106	785	74 353	394	44 425
December	4 220	86 502	2 044	77 790	977	77 988	270	41 206

Source: COMEX, Statistical Yearbook.

Copper: Contracts for 25 short tons.
Aluminum: Contracts for 40 short tons.

Table II.1

COPPER

WORLD MINERAL PRODUCTION, 1987

Country	Mineral production thousands (MT)	Percentage
World total	8 657	100.0
Chile	1 418	16.4
U.S.A.	1 256	14.5
U.S.S.R.	1 010	11.6
Canada	767	8.8
Zambia	527	6.1
Zaire	500	5.8
Poland	438	5.1
Peru	396	4.6
China	260	3.0
Mexico	248	2.9
Australia	232	2.7
Other Latin America		
Brazil	39	0.4
Total Latin America	2 101	24.3
Rest of the world	1 566	18.1

Source: Service études et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

Table II.2

COPPER

WORLD PRODUCTION OF REFINED COPPER, 1987

Country	Refined copper production thousands (MT)	Percentage
World total	10 184	100.0
U.S.A.	1 561	15.4
U.S.S.R.	1 430	14.1
Japan	980	9.6
Chile	972	9.5
Zambia	509	5.0
Canada	491	4.8
China	400	3.9
Germany (FRG)	400	3.9
Poland	390	3.8
Belgium-Luxembourg	313	3.1
Zaire	305	3.0
Other Latin America		
Peru	218	2.1
Brazil	176	1.7
Mexico	120	1.2
Argentina	13	0.1
Total Latin America	1 499	14.7
Rest of the world	1 906	18.8

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

Table II.3

COPPER

WORLD CONSUMPTION OF REFINED COPPER, 1987

Country	Refined copper consumption thousands of (MT)	Percentage
World total	10 428	100.0
U.S.A.	2 135	20.5
U.S.S.R.	1 290	12.4
Japan (1)	1 284	12.3
Germany (FRG)	800	7.7
China	470	4.5
Italy	420	4.0
France	399	3.8
United Kingdom	328	3.1
Belgium-Luxembourg	292	2.8
Republic of Korea	259	2.5
Brazil	259	2.5
Canada	232	2.2
Other Latin America		
Mexico	109	1.0
Argentina	64	0.6
Chile	47	0.5
Peru	43	0.4
Venezuela	22	0.2
Total Latin America	544	5.2
Rest of the world	1 975	19.0

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

(1) Apparent consumption.

Table II.4

COPPER

ANNUAL PRICES: 1950-1988

Period	Nominal copper LME c/Lb	Nominal copper COMEX c/Lb	Nominal copper AVG U.S.A. c/Lb	Real copper LME c/Lb	Real copper COMEX c/Lb	Real copper AVG U.S.A. c/Lb
1950	22.4	n.a.	21.2	89.1	n.a.	84.6
1951	27.5	n.a.	24.2	98.7	n.a.	86.7
1952	32.3	n.a.	24.2	118.9	n.a.	89.0
1953	32.2	n.a.	28.8	120.1	n.a.	107.5
1954	31.3	n.a.	29.7	116.2	n.a.	110.4
1955	43.9	42.7	37.5	163.2	158.8	139.4
1956	41.1	39.8	41.8	147.7	143.2	150.4
1957	27.5	27.2	29.6	96.0	95.2	103.4
1958	24.7	25.3	25.8	85.3	87.2	88.8
1959	29.7	31.2	31.2	102.2	107.1	107.2
1960	30.8	30.7	32.1	105.7	105.6	110.1
1961	28.7	29.9	29.9	99.0	103.2	103.2
1962	29.3	29.2	30.6	100.6	100.4	105.2
1963	29.3	29.8	30.6	101.0	102.7	105.5
1964	44.1	42.9	32.0	152.1	148.1	110.2
1965	58.7	50.5	35.0	198.4	170.5	118.3
1966	69.5	63.2	36.2	227.0	206.4	118.2
1967	51.1	50.4	38.2	166.5	164.1	124.5
1968	56.1	51.1	41.8	178.7	162.8	133.3
1969	66.6	63.9	47.8	203.6	195.3	146.3
1970	64.2	61.3	57.7	189.9	181.3	170.7
1971	49.3	49.1	51.4	140.8	140.1	147.0
1972	48.6	49.1	51.2	133.0	134.6	140.4
1973	80.8	78.4	59.5	195.6	189.9	144.0
1974	93.3	90.2	77.3	190.0	183.6	157.4
1975	55.9	55.5	64.2	104.4	103.6	119.7
1976	63.6	64.1	69.6	113.4	114.2	124.0
1977	59.3	60.3	66.8	99.6	101.3	112.2
1978	61.9	62.2	66.5	96.4	96.8	103.6
1979	89.8	88.5	93.3	124.4	122.5	129.3
1980	99.2	96.8	102.4	120.4	117.4	124.3
1981	78.9	78.7	85.1	87.9	87.6	94.8
1982	67.1*	65.8	74.3	73.0*	71.7	80.9
1983	72.2	71.9	79.3	77.7	77.4	85.3
1984	62.4	61.3	68.2	65.6	64.4	71.6
1985	64.3	61.0	67.0	67.9	64.4	70.7
1986	62.3	61.6	66.1	67.8	67.1	71.9
1987	81.1	77.8	82.5	85.9	82.5	87.4
1988	117.9	114.6	120.5	120.2	116.8	122.8

Source: Metals Week Price Handbook.

* 1982-1988: High-grade copper. Prior to December 1981: wirebars.

Deflator: U.S. W.P.I.: December 1988=100.

Table II.5

BAUXITE

WORLD PRODUCTION, 1987

Country	Production thousands (MT)	Percentage
World total	95 300	100.0
Australia	34 206	35.9
Guinea	16 282	17.1
Jamaica	7 660	8.0
Brazil	6 567	6.9
U.S.S.R. (1)	4 850	5.1
Yugoslavia	3 394	3.6
Hungary	3 101	3.3
Guiana	2 785	2.9
India	2 779	2.9
China	2 750	2.9
Suriname	2 581	2.7
Other Latin America		
Venezuela	217	0.2
Dominican Republic	211	0.2
Total Latin America	14 655	15.4
Rest of the world	7 917	8.3

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

(1) Estimate.

Table II.6

ALUMINUM

WORLD PRODUCTION, 1987

Country	Production thousands (MT)	Percentage
World total	36 468	100.0
Australia	10 109	27.7
U.S.S.R.	4 580	12.6
U.S.A.	4 150	11.4
Jamaica	1 609	4.4
Brazil	1 396	3.8
Suriname	1 363	3.7
Venezuela	1 360	3.7
Germany (FRG)	1 313	3.6
China	1 215	3.3
Canada	1 112	3.0
Total Latin America	4 365	12.0
Rest of the world	7 309	20.0

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

Table II.7

ALUMINUM

WORLD PRODUCTION, 1987

Country	Production thousands (MT)	Percentage
World total	16 321	100.0
U.S.A.	3 343	20.5
U.S.S.R.	2 370	14.5
Canada	1 540	9.4
Australia	1 024	6.3
Brazil	844	5.2
Norway	798	4.9
Germany (FRG)	738	4.5
China	540	3.3
Venezuela	440	2.7
Spain	341	2.1
France	323	2.0
Other Latin America		
Argentina	155	0.9
Mexico	60	0.4
Total Latin America	1 499	9.2
Rest of the world	3 805	23.3

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

Table II.8

ALUMINUM

WORLD CONSUMPTION, 1987

Country	Production thousands (MT)	Percentage
World total	17 176	100.0
U.S.A.	4 536	26.4
U.S.S.R.	1 800	10.5
Libya	1 750	10.2
Germany (FRG)	1 186	6.9
China	800	4.7
France	616	3.6
Italy	548	3.2
Brazil	430	2.5
Canada	421	2.5
United Kingdom	383	2.2
Indonesia	326	1.9
Australia	312	1.8
Other Latin America		
Venezuela	145	0.8
Argentina	142	0.8
Mexico	68	0.4
Colombia	22	0.1
Total Latin America	807	4.7
Rest of the world	3 691	21.5

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

(1) Apparent consumption.

Table II.9

ALUMINUM

ANNUAL PRICES: 1950-1988

(Nominal and real)

Period	Nominal aluminum United Kingdom c/Lb	Nominal aluminum LME c/Lb	Nominal aluminum AVG U.S.A. c/Lb	Real aluminum United Kingdom c/Lb	Real aluminum LME c/Lb	Real alumium AVG U.S.A. c/Lb
1950	14.2		17.7	56.6		70.5
1951	15.5		19.0	55.6		68.1
1952	19.4		19.4	71.3		71.3
1953	19.7		20.9	73.5		78.0
1954	19.6		21.8	72.9		81.0
1955	20.8		23.7	77.3		88.1
1956	23.8		26.0	85.6		93.5
1957	24.6		27.5	86.0		96.2
1958	23.1		26.9	79.7		92.8
1959	22.6		26.8	77.7		92.1
1960	23.3		26.0	80.1		89.3
1961	23.3		25.5	80.3		87.9
1962	22.7		23.9	78.0		82.1
1963	22.6		22.6	77.9		77.9
1964	23.8		23.7	82.1		81.7
1965	24.5		24.5	82.8		82.8
1966	24.4		24.5	79.7		80.1
1967	24.5		25.0	79.8		81.4
1968	25.0		25.6	79.6		81.5
1969	26.5		27.2	81.0		83.2
1970	27.8		28.7	82.2		84.9
1971	28.5		29.0	81.4		82.9
1972	26.6		26.4	72.9		72.3
1973	26.3		25.0	63.7		60.5
1974	34.7		34.1	70.7		69.5
1975	39.5		39.8	73.7		74.3
1976	40.4		44.3	72.0		79.0
1977	51.9		51.3	87.2		86.2
1978	60.1		53.1	93.6		82.7
1979		72.7	59.4		100.7	82.3
1980		80.8	69.6		98.1	84.5
1981		57.3	76.0		63.8	84.6
1982		45.0	76.0		49.0	82.8
1983		65.3	77.7		70.3	83.6
1984		56.5	81.0		59.3	85.1
1985		47.9	81.0		50.6	85.5
1986		52.2	81.0		56.8	88.1&
1987		71.2	n.a.		75.4	n.a.
1988		117.3*	n.a.		119.6*	n.a.

Source: Metals Week Price Handbook.

* High-grade aluminum.
& Quotation suspended September 1986.

Deflator: U.S. W.P.I., December 1988=100.

Table II.10

ZINC

WORLD MINERAL PRODUCTION, 1987

Country	Mineral production thousands (MT)	Percentage
World total	7 131	100.0
Canada	1 500	21.0
U.S.S.R.	950	13.3
Australia	754	10.6
Peru	593	8.3
China	292	4.1
Mexico	283	4.0
Spain	266	3.7
U.S.A.	233	3.3
The Democratic People's Republic of Korea	220	3.1
Sweden	219	3.1
Poland	186	2.6
Other Latin America		
Brazil	93	1.3
Bolivia	39	0.5
Argentina	36	0.5
Chile	20	0.3
Honduras	12	0.2
Total Latin America	1 076	15.1
Rest of the world	1 435	20.1

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

Table II.11

ZINC

WORLD PRODUCTION OF REFINED ZINC, 1987

Country	Metallurgical production thousands (MT)	Percentage
World total	7 010	100.0
U.S.S.R.	1 045	14.9
Japan	666	9.5
Canada	611	8.7
Germany (FRG)	378	5.4
China	357	5.1
U.S.A.	343	4.9
Australia	310	4.4
Belgium-Luxembourg	285	4.1
France	249	3.5
Italy	247	3.5
The Democratic People's Republic of Korea	225	3.2
Spain	214	3.0
Other Latin America		
Mexico	186	2.6
Peru	145	2.1
Brazil	139	2.0
Argentina	32	0.5
Total Latin America	502	7.2
Rest of the world	1 587	22.6

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

Table II.12

ZINC

WORLD CONSUMPTION OF REFINED ZINC, 1987

Country	Consumption thousands (MT)	Percentage
World total	6 867	100.0
U.S.A.	1 052	15.3
U.S.S.R.	1 010	14.7
Japan	728	10.6
Germany (FRG)	452	6.6
China	360	5.3
France	248	3.6
Italy	245	3.6
United Kingdom	188	2.7
Republic of Korea	179	2.6
Brazil	177	2.6
Canada	167	2.4
Other Latin America		
Mexico	110	1.6
Peru	60	0.9
Argentina	38	0.6
Venezuela	21	0.3
Colombia	10	0.1
Chile	9	0.1
Total Latin America	425	6.2
Rest of the world	1 813	26.4

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

Table II.13

ZINC

ANNUAL PRICES: 1950-1988

(Nominal and real)

Period	Nominal zinc LME c/Lb	Nominal zinc AVG U.S.A. c/Lb	Nominal zinc PR. Europe c/Lb	Real zinc LME c/Lb	Real zinc AVG U.S.A. c/Lb	Real zinc PR. Europe c/Lb
1950	14.9	13.9	-	59.4	55.2	-
1951	21.5	18.0	-	77.1	64.5	-
1952	18.6	16.2	-	68.4	59.6	-
1953	9.4	10.9	-	35.1	40.5	-
1954	9.8	10.7	-	36.4	39.7	-
1955	11.3	12.3	-	42.0	45.7	-
1956	12.2	13.5	-	43.9	48.5	-
1957	10.2	11.4	-	35.7	39.9	-
1958	8.3	10.3	-	28.6	35.5	-
1959	10.3	11.4	-	35.4	39.3	-
1960	11.2	12.9	-	38.5	44.5	-
1961	9.7	11.5	-	33.4	39.8	-
1962	8.5	11.6	-	29.2	39.9	-
1963	9.6	12.0	-	33.1	41.4	-
1964	14.7	13.6	-	50.7	46.8	-
1965	14.1	14.5	-	47.6	49.0	-
1966	12.7	14.5	-	41.5	47.4	-
1967	12.3	13.8	-	40.1	45.1	-
1968	11.9	13.5	-	37.9	43.0	-
1969	12.9	14.6	-	39.4	44.6	-
1970	13.4	15.3	-	39.6	45.3	-
1971	14.1	16.1	-	40.3	46.1	-
1972	17.1	17.8	-	46.8	48.6	-
1973	38.6	20.7	-	93.5	50.0	-
1974	56.2	35.9	-	114.5	73.2	-
1975	33.8	39.0	36.9	63.1	72.7	68.9
1976	32.3	37.0	n.a.	57.6	66.0	n.a.
1977	26.8	34.4	32.4	45.0	57.8	54.4
1978	26.9	31.0	27.4	41.9	48.2	42.7
1979	33.6	37.3	35.8	46.5	51.7	49.6
1980	34.5	37.4	36.1	41.9	45.4	43.8
1981	39.0	44.6	41.3	43.4	49.6	46.0
1982	33.8	38.5	37.8	36.8	41.9	41.2
1983	34.8	41.4	37.2	37.5	44.5	40.0
1984	40.5	48.6	45.3	42.5	51.1	47.6
1985	36.3	40.4	37.9	38.3	42.6	40.1
1986	34.2*	38.0	36.0	37.2*	41.3	39.2
1987	36.3	41.9	37.2	38.5	44.4	39.4
1988	56.3	60.2	n.a.	57.4	61.4	n.a.

Source: Metals Week Price Handbook.

* 1986 to 1988: high-grade zinc.

Deflator: U.S. W.P.I.: December 1988=100.

Table II.14

LEAD

WORLD MINERAL PRODUCTION, 1987

Country	Mineral production thousands (MT)	Percentage
World total	3 404	100.0
U.S.S.R.	510	15.0
Australia	486	14.3
Canada	413	12.1
U.S.A.	318	9.3
China	237	7.0
Peru	192	5.6
Mexico	177	5.2
South Africa	96	2.8
Bulgaria	95	2.8
Sweden	90	2.6
The Democratic People's Republic of Korea	90	2.6
Other Latin America		
Argentina	26	0.8
Brazil	13	0.4
Bolivia	9	0.3
Honduras	5	0.1
Chile	1	0.1
Total Latin America	423	12.4
Rest of the world	646	19.0

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

Table II.15

LEAD

WORLD PRODUCTION OF REFINED LEAD, 1987

Country	Refined production thousands (MT)	Percentage
World total	5 632	100.0
U.S.A.	1 028	18.3
U.S.S.R.	780	13.8
United Kingdom	347	6.2
Germany (FRG)	340	6.0
Japan	339	6.0
France	246	4.4
China	239	4.2
Canada	226	4.0
Australia	217	3.9
Mexico	185	3.3
Italy	168	3.0
Other Latin America		
Brazil	84	1.5
Peru	79	1.4
Argentina	32	0.6
Venezuela	19	0.3
Total Latin America	399	7.1
Rest of the world	1 303	23.1

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

Table II.16

LEAD

WORLD CONSUMPTION OF REFINED LEAD, 1987

Country	Refined consumption thousands (MT)	Percentage
World total	5 624	100.0
U.S.A.	1 203	21.4
U.S.S.R.	775	13.8
Japan	378	6.7
Germany (FRG)	345	6.1
United Kingdom	288	5.1
Italy	244	4.3
China	240	4.3
France	208	3.6
Yugoslavia	129	2.3
Republic of Korea	112	2.0
Spain	106	1.9
Canada	103	1.8
Other Latin America		
Mexico	100	1.8
Brazil	93	1.7
Argentina	32	0.6
Venezuela	26	0.5
Peru	22	0.4
Total Latin America	273	4.9
Rest of the world	1 220	21.7

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

Table II.17

LEAD

ANNUAL PRICES: 1950-1988

(Nominal and real)

Period	Nominal lead LME c/Lb	Nominal lead AVG U.S.A. c/Lb	Real lead LME c/Lb	Real lead AVG U.S.A. c/Lb
1950	13.3	13.3	53.0	53.0
1951	20.3	17.5	72.8	62.7
1952	17.0	16.5	62.5	60.5
1953	11.5	13.5	42.9	50.3
1954	12.1	14.1	45.0	52.2
1955	13.2	15.1	49.1	56.3
1956	14.5	16.0	52.2	57.6
1957	12.1	14.7	42.3	51.3
1958	9.1	12.1	31.4	41.8
1959	8.9	12.2	30.6	42.0
1960	9.0	11.9	30.9	41.1
1961	8.0	10.9	27.6	37.5
1962	7.1	9.6	24.4	33.1
1963	7.9	11.1	27.2	38.4
1964	12.6	13.6	43.4	46.9
1965	14.4	16.0	48.6	54.1
1966	11.9	15.1	38.9	49.4
1967	10.3	14.0	33.6	45.6
1968	10.9	13.2	34.7	42.1
1969	13.1	14.9	40.1	45.6
1970	13.7	15.6	40.5	46.2
1971	11.5	13.8	32.9	39.4
1972	13.7	15.0	37.5	41.2
1973	19.5	16.3	47.2	39.4
1974	26.9	22.5	54.8	45.9
1975	18.8	21.5	35.1	40.2
1976	20.3	23.1	36.2	41.2
1977	28.0	30.7	47.1	51.6
1978	29.9	33.7	46.6	52.4
1979	54.6	52.6	75.6	72.9
1980	41.3	42.5	50.1	51.5
1981	33.3	36.5	37.1	40.7
1982	24.7	25.5	26.9	27.8
1983	19.3	21.7	20.8	23.3
1984	20.1	25.5	21.1	26.8
1985	17.9	19.1	18.9	20.1
1986	18.4	25.7*	20.0	28.0*
1987	27.0	35.9	28.6	38.1
1988	29.8	37.1	30.4	37.9

Source: World Metals Statistics, 1989. Metals Week Price Handbook.

* 1986-1988: price NA; producer mean.

Deflator: U.S. W.P.I.: December 1988=100.

Table II.18

TIN

WORLD MINERAL PRODUCTION, 1987

Country	Mineral production thousands (MT)	Percentage
World total	187	100.0
Malaysia	30	16.0
Brazil	29	15.5
China	28	15.0
Indonesia	26	13.9
U.S.S.R.	15	8.0
Thailand	15	8.0
Bolivia	8	4.3
Australia	8	4.3
Other Latin America		
Peru	5	2.7
Total Latin America	42	22.5
Rest of the world	23	12.3

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

Table II.19

TIN

WORLD METALLURGICAL PRODUCTION, 1987

Country	Metallurgical production thousands (MT)	Percentage
World total	205	100.0
Malaysia	44	21.5
Brazil (1)	29	14.1
China	25	12.2
Indonesia	24	11.7
U.S.S.R.	17	8.3
United Kingdom	17	8.3
Thailand	16	7.8
Other Latin America		
Mexico	4	2.0
Bolivia	3	1.5
Total Latin America	36	17.6
Rest of the world	26	12.6

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

(1) Includes production of tin 2-fusion.

Table II.20

TIN

WORLD CONSUMPTION, 1987

Country	Consumption thousands (MT)	Percentage
World total	228	100.0
U.S.A.	37	16.2
Japan	33	14.5
U.S.S.R.	29	12.7
Germany (FRG)	18	7.9
China	14	6.2
United Kingdom	10	4.4
Brazil	8	3.5
France	7	3.1
Italy	6	2.6
Republic of Korea	6	2.6
The Netherlands	5	2.2
Other Latin America		
Mexico	3	1.3
Argentina	1	0.4
Total Latin America	12	5.3
Rest of the world	51	22.4

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

Table II.21

TIN

ANNUAL PRICES: 1950-1988

(Nominal and real)

Period	Nominal tin LME c/Lb	Nominal tin New York # c/Lb	Nominal tin Kuala Lumpur c/Lb	Real tin LME c/Lb	Real tin New York # c/Lb	Real tin Kuala Lumpur c/Lb
1950	93.3	95.5	-	371.7	380.6	-
1951	134.9	127.1	-	483.5	455.5	-
1952	120.2	120.5	-	441.9	442.9	-
1953	91.5	95.8	-	341.4	357.6	-
1954	90.3	91.8	-	335.7	341.4	-
1955	92.3	94.7	-	343.1	352.2	-
1956	98.4	101.4	-	354.0	364.8	-
1957	94.2	96.3	-	329.4	336.6	-
1958	92.2	95.1	-	317.9	328.0	-
1959	98.5	102.1	-	338.5	350.7	-
1960	99.9	101.4	-	343.3	348.6	-
1961	111.2	113.3	-	383.4	390.7	-
1962	112.4	114.7	-	386.3	394.0	-
1963	113.8	116.7	-	392.4	402.2	-
1964	154.7	157.6	-	533.4	543.4	-
1965	176.5	178.2	-	596.3	602.0	-
1966	161.7	164.1	-	528.4	536.2	-
1967	150.1	153.4	-	488.9	499.8	-
1968	141.5	148.2	-	450.6	471.8	-
1969	154.9	164.5	-	473.7	503.1	-
1970	166.3	174.2	-	492.0	515.4	-
1971	159.4	167.3	-	455.4	478.1	-
1972	171.0	177.5	-	468.5	486.2	-
1973	218.9	227.6	-	530.0	551.0	-
1974	371.9	396.3	-	757.4	807.1	-
1975	311.6	339.8	303.6	581.3	634.0	566.3
1976	344.6	379.8	n.a.	614.3	677.0	n.a.
1977	491.1	534.6	486.0	825.4	898.5	816.7
1978	584.6	629.6	567.6	910.6	980.7	884.2
1979	702.4	753.9	672.3	972.9	1 044.2	931.2
1980	763.1	846.0	745.6	926.1	1 026.7	904.8
1981	650.0	733.0	637.8	723.8	816.3	710.3
1982	581.0	653.9	587.3	632.9	712.3	639.8
1983	591.3	654.8	590.8	636.5	704.8	635.9
1984	558.4	567.8	564.9	586.6	596.4	593.4
1985	556.4*	525.9	540.7	587.5*	555.3	571.0
1986	n.a.	294.1	291.6	n.a.	320.0	317.3
1987	n.a.	315.6	303.5	n.a.	334.3	321.5
1988	n.a.	319.9	n.a.	n.a.	326.1	n.a.

Source: Metals Week Price Handbook.

* Quotation suspended October 1985.

Deflator: U.S. W.P.I.: December 1988=100.

NY dealer.

Table II.22

NICKEL

WORLD MINERAL PRODUCTION, 1987

Country	Mineral production thousands (MT)	Percentage
World total	818	100.0
Canada	220	26.9
U.S.S.R.	173	21.2
Australia	73	8.9
New Caledonia	59	7.2
Indonesia	57	7.0
Cuba	40	4.9
Dominican Republic	33	4.0
China	30	3.7
South Africa	29	3.5
Other Latin America		
Colombia	19	2.3
Brazil	13	1.6
Total Latin America	105	12.8
Rest of the world	72	8.8

Source: Service étude et statistiques, Penarroya, Annuaire Minement, 1987, Paris, 1987.

Table II.23

NICKEL

WORLD METALLURGICAL PRODUCTION, 1987

Country	Metallurgical production thousands (MT)	Percentage
World total	782	100.0
U.S.S.R.	191	24.4
Canada	132	16.9
Japan	94	12.0
Norway	45	5.8
Australia	45	5.8
Dominican Republic	33	4.2
United Kingdom	30	3.8
New Caledonia	30	3.8
China	29	3.7
Other Latin America		
Colombia	19	2.4
Brazil	13	1.7
Total Latin America	65	8.3
Rest of the world	121	15.5

Source: Service études et statistiques, Penarroya, Annuaire Minement 1987, Paris, 1987.

Table II.24

NICKEL

WORLD CONSUMPTION, 1987

Country	Consumption thousands (MT)	Percentage
World total	853	100.0
Japan	154	18.0
U.S.A.	148	17.3
U.S.S.R.	138	16.2
Germany (FRG)	81	9.5
France	39	4.6
United Kingdom	33	3.9
Italy	29	3.4
China	25	2.9
India	19	2.2
Sweden	19	2.2
Taiwan	16	1.9
Other Latin America		
Brazil	15	1.8
Mexico	3	0.4
Total Latin America	18	2.1
Rest of the world	134	15.7

Source: Annuaire Minement, 1987.

Table II.25

NICKEL

ANNUAL PRICES: 1950 TO 1988

(Nominal and real)

Period	Nominal nickel AVG U.S.A. c/Lb	Nominal nickel LME c/Lb	Real nickel AVG U.S.A. c/Lb	Real nickel LME c/Lb
1950	44.8	-	178.5	-
1951	54.0	-	193.5	-
1952	56.5	-	207.7	-
1953	59.9	-	223.5	-
1954	60.5	-	224.9	-
1955	64.5	-	239.8	-
1956	65.1	-	234.2	-
1957	74.0	-	258.7	-
1958	74.0	-	255.2	-
1959	74.0	-	254.3	-
1960	74.0	-	254.3	-
1961	77.7	-	267.9	-
1962	79.9	-	274.6	-
1963	79.0	-	272.4	-
1964	79.0	-	272.4	-
1965	78.7	-	265.9	-
1966	78.9	-	257.8	-
1967	87.8	-	286.0	-
1968	94.0	-	299.4	-
1969	105.4	-	322.3	-
1970	129.1	-	382.0	-
1971	133.0	-	380.0	-
1972	139.7	-	382.7	-
1973	153.0	-	370.5	-
1974	173.5	-	353.4	-
1975	207.3	-	386.8	-
1976	225.6	-	402.1	-
1977	236.0	-	396.6	-
1978	209.1	-	325.7	-
1979	270.7	258.3	374.9	357.8
1980	341.5	295.8	414.4	359.0
1981	342.9	270.6	381.8	301.3
1982	320.0	218.3	348.6	237.8
1983	320.0	212.0	344.5	228.2
1984	320.0	216.4	336.1	227.3
1985	320.0	225.8	337.9	238.4
1986	320.0	176.1	348.2	191.6
1987	320.0*	219.3	339.0*	232.3
1988	n.a.	1 113.3	n.a.	1 134.8

Source: Metals Week Price Handbook.

* Quotation suspended December 1987.

Deflator: U.S. W.P.I.: December 1988=100.

Table II.26

ANNUAL EXCHANGE RATES: 1950-1988

(Deflator U.S. W.P.I. December 1988=100)

Period	Exchange rate	Deflator U.S. W.P.I.
1950	2 800.7	25.1
1951	2 799.6	27.9
1952	2 792.6	27.2
1953	2 812.7	26.8
1954	2 808.7	26.9
1955	2 791.3	26.9
1956	2 795.7	27.8
1957	2 793.2	28.6
1958	2 809.8	29.0
1959	2 808.8	29.1
1960	2 807.6	29.1
1961	2 802.2	29.0
1962	2 807.8	29.1
1963	2 800.0	29.0
1964	2 792.1	29.0
1965	2 795.9	29.6
1966	2 793.0	30.6
1967	2 750.4	30.7
1968	2 394.5	31.4
1969	2 390.1	32.7
1970	2 395.9	33.8
1971	2 444.2	35.0
1972	2 500.8	36.5
1973	2 451.0	41.3
1974	2 340.3	49.1
1975	2 221.6	53.6
1976	1 804.8	56.1
1977	1 744.9	59.5
1978	1 918.4	64.2
1979	2 122.4	72.2
1980	2 325.8	82.4
1981	2 024.3	89.8
1982	1 749.5	91.8
1983	1 515.9	92.9
1984	1 335.6	95.2
1985	1 295.6	94.7
1986	1 466.8	91.9
1987	1 639.3	94.4
1988	1 781.3	98.1

Table II.27

DEFLATOR
U.S. W.P.I.
1975=100
PERIOD

1950	46.8
1951	52.1
1952	50.7
1953	50.0
1954	50.1
1955	50.2
1956	51.9
1957	53.3
1958	54.1
1959	54.2
1960	54.3
1961	54.1
1962	54.2
1963	54.0
1964	54.1
1965	55.2
1966	57.1
1967	57.2
1968	58.6
1969	60.9
1970	63.1
1971	65.2
1972	68.1
1973	77.0
1974	91.5
1975	100.0
1976	104.6
1977	111.0
1978	119.7
1979	134.7
1980	153.6
1981	167.5
1982	171.2
1983	173.3
1984	177.5
1985	176.6
1986	171.4
1987	176.0
1988	183.0

ANNEXES

ANNEX I

CHARACTERISTICS OF FUTURES CONTRACTS FOR NON-FERROUS METALS

1. THE LONDON METAL EXCHANGE

1.1 FUTURES CONTRACTS

1.1.1 COPPER

NAME OF THE CONTRACT: "GRADE A - Electrolytic Copper"

- DELIVERABLE GRADES:	Grade A cathodes or Grade A wirebars of standard dimensions in the weight range of 110 kg to 125 kg in seller's option. All copper delivered must be of brands listed in the LME approved list of Copper - Grade A brands and conform with the appropriate category of British Standard 6017 - 1981.
- CONTRACT UNIT	25 tons.
- PRICE BASIS	£ per ton.
- MINIMUM PRICE MOVEMENT	£ 0.50 per ton.
- DELIVERY DATES	Daily for three months forward, then the third Wednesday of the month for next 12 months.
- RING TRADING TIMES (official)	12.00 - 12.05 12.30 - 12.35 15.30 - 15.35 16.15 - 16.20

1.1.2 ALUMINUM

NAME OF THE CONTRACT: "High Grade Primary Aluminum"

- DELIVERABLE GRADES:	Aluminum of minimum 99.70% purity in the form of ingots, T-bars or sows. Ingot weights range from 12 kg to 26 kg each, the maximum permitted T-bar weight is 675 kg and the maximum permitted weight of each sow is 750 kg.

- CONTRACT UNIT	25 tons.
- PRICE BASIS	US$ per ton.
- MINIMUM PRICE MOVEMENT	US$1 per ton.
- DELIVERY DATES	Daily for three months forward, then the third Wednesday of the month for next 12 months.
- RING TRADING TIMES (official)	11.50 - 11.55 12.55 - 13.00 15.35 - 15.40 16.20 - 16.25

1.1.3 ZINC

NAME OF THE CONTRACT: "Special High-Grade Zinc"

- DELIVERABLE GRADES:	Zinc of minimum 99.995% purity produced in the form of slabs, plates or ingots weighing not more than 55 kg each. All zinc delivered must be of brands listed in the LME approved list of Special High-Grade Zinc brands.
- CONTRACT UNIT	25 tons.
- PRICE BASIS	US$ per ton.
- MINIMUM PRICE MOVEMENT	50 cents per ton.
- DELIVERY DATES	Daily for three months forward, then the third Wednesday of the month for next 12 months.
- RING TRADING TIMES (official)	12.10 - 12.15 12.50 - 12.55 15.25 - 15.30 16.10 - 16.15

NAME OF CONTRACT: "High-Grade Zinc"

- DELIVERABLE GRADES:	Zinc of minimum 99.950% purity produced in the form of slabs, plates or ingots weighing not more than 55 kg each. All zinc delivered must be of brands listed in the LME approved list of High-Grade Zinc brands.

- CONTRACT UNIT	25 tons.
- PRICE BASIS	US$ per ton.
- MINIMUM PRICE MOVEMENT	50 cents per ton.
- DELIVERY DATES	Daily for three months forward, then the third Wednesday of the month for next 12 months.
- RING TRADING TIMES (official)	12.10 - 12.15 12.45 - 12.50 15.25 - 15.30 16.05 - 16.10

1.1.4 LEAD

NAME OF CONTRACT: "Refined Pig Lead"

- DELIVERABLE GRADES:	Lead assaying not less than 99.97% purity in pigs weighing not more than 55 kg each. All lead delivered must be of brands listed in the LME approved list of Lead brands.
- CONTRACT UNIT	25 tons.
- PRICE BASIS	£ per ton.
- MINIMUM PRICE MOVEMENT	£0.25 per ton.
- DELIVERY DATES	Daily for three months forward, then the third Wednesday of the month for next 12 months.
- RING TRADING TIMES (official)	12.05 - 12.10 12.40 - 12.45 15.20 - 15.25 16.00 - 16.05

1.1.5 NICKEL

NAME OF CONTRACT: "Primary Nickel"

- DELIVERABLE GRADES:	Nickel of minimum 99.80% purity with chemical analysis conforming to the current ASTM specification, in the form of cathodes, pellets or briquettes. All nickel delivered must be of the production of producers

named in the LME approved Nickel list.

- CONTRACT UNIT: 6 tons.
- PRICE BASIS: US$ per ton.
- MINIMUM PRICE MOVEMENT: US$1 per ton.
- DELIVERY DATES: Daily for three months forward, then the third Wednesday of the month for next 12 months.
- RING TRADING TIMES (official):
  12.15 - 12.20
  13.05 - 13.10
  15.45 - 15.50
  16.30 - 16.35

1.1.6 SILVER

NAME OF CONTRACT: "Silver"

- DELIVERABLE GRADES: Silver of a minimum fineness of 0.999 in the form of bars in the weight range of 450 troy ounces to 1 250 troy ounces. All silver delivered must be of brands listed in the LME approved list of Silver.
- CONTRACT UNIT - Large: 10 000 troy ounces.
  - Small: 2 000 troy ounces.
- PRICE BASIS: US$ cents per troy ounce.
- MINIMUM PRICE MOVEMENT: 0.1 cent per troy ounce.
- DELIVERY DATES: Daily for three months forward, then the third Wednesday of the month for next 12 months.
- RING TRADING TIMES (official):
  12.45 - 12.50
  13.10 - 13.15
  15.50 - 15.55
  16.35 - 16.40

1.2 OPTIONS CONTRACTS

METAL	MONTHS TRADED	STRIKE PRICE GRADATION
Aluminum	January and every	£25 / US$50 per ton
Copper Grade "A" only	second month thereafter	£25 / US$50 per ton
Lead	February and every	£20 / US$20 per ton
Zinc	second month	£20 / US$20 per ton
Nickel	thereafter	£50 / US$100 per ton
Silver	thereafter	25p / 25c per troy ounce

Where strike prices are above US$3 000 per ton the gradation increases to US$100 per ton.

In the case of Aluminum and Copper Grade "A" the nearest six or designated months are tradeable in US dollars and the nearest three are tradeable in Sterling. For Nickel the nearest three designated months are tradeable in US dollars and the nearest two are tradeable in Sterling.

For the other three metals only the nearest two designated months are tradeable in either currency.

1.3 DELIVERY POINTS (WAREHOUSES)

UNITED KINGDOM	Avonmouth, Birmingham, Glasgow, Goole, Harwich, Hull, Liverpool, London and New Castle.
EUROPE	Antwerp, Brussels,* Gothenburg, Helsingborg, Amsterdam (1), Rotterdam, Genoa, Leghorn, Trieste, Bremen, Frankfurt(1), Hamburg and Dunkirk.
FAR EAST	Singapore and Japan.

* For silver storage only.

ANNEX II

COMEX (COMMODITY EXCHANGE, INC.)

2.1 FUTURE CONTRACTS

2.1.1 COPPER

NAME OF THE CONTRACT: "COPPER"

- TRADING UNIT	25 000 pounds.
- TRADING HOURS	9.25 - 14.00, New York time.
- DELIVERABLE GOODS	Base grade: Grade 2 electrolytic cathode copper. Other grades: Grade 1 electrolytic cathode, with a premium of 1-1/2 cents per pound over the base grade. - Grade 1 electrolytic ingots, with a premium of 1-1/4 cents per pound. - Fire-refined high conductivity ingots and wirebars at par with the base grade. - Fire-refined copper ingots, at a discount of 1/8 cents per pound.

All copper delivered must conform to specifications established by the American Society for Testing and Materials and be of a brand approved and listed by COMEX.

- TRADING MONTHS	The current month, the two following months and any January, March, May, July, September and December falling within a 23-month period beginning with the current month.
- PRICE MULTIPLES	Price changes are registered in multiples of five one-hundredths of a cent (5/100 of 1 cent) per pound.

NAME OF CONTRACT: "HIGH-GRADE COPPER"

- TRADING UNIT	25 000 pounds.
- TRADING HOURS	9.25 - 14.00, New York time.
- TRADING MONTHS	The current month, the 11 following months and any January, March, May, July, September and December falling within a 23-month period beginning with the current month.
- MINIMUM PRICE FLUCTUATION	US$0.0005 per pound (= US$12.50 per contract).
- LAST TRADING DAY	Third from the last business day of the maturing delivery month.
- DELIVERY	25 000 pounds (2% more or less) of Grade 1 electrolytic copper.

2.1.2 ALUMINUM

- TRADING UNIT	40 000 pounds (44 000 pounds starting in September 1989).
- TRADING HOURS	9.30 - 14.10, New York time.
- DELIVERABLE GRADES	Aluminum P 1020 in ingots, T-bars or sows.
- TRADING MONTHS	The current month, the two following months and any January, March, May, July, September and December falling within a 23-month period beginning with the current month.
- PRICE MULTIPLES	Price changes are registered in multiples of five one-hundredths of a cent (5/100 of 1 cent per pound).

2.2 OPTIONS CONTRACTS

2.2.1 COPPER

NAME OF THE CONTRACT: "COPPER"

- CONTRACT MONTHS	The four closest months to the following months: March, May, July, September and December.
- TRADING HOURS	9.25 - 14.00, New York time.
- UNDERLYING ASSET	One COMEX copper futures contract (25 000 pounds).
- MINIMUM PRICE FLUCTUATION	US$0.0005 per pound (= US$12.50 per contract).
- STRIKE PRICE INCREMENTS	One cent per pound for strike prices equal to or below 40 cents, 2 cents per pound for strike prices between 40 cents and US$1, and 5 cents per pound for strike prices above US$1. On the first day of trading for any option contract month, there will be nine strike prices each for puts and calls.
- LAST TRADING DAY	Second Friday of the month prior to the delivery month of the underlying futures contract.
- EXERCISE	Until 15.00, New York time, on any business day for which the option is listed for trading.

NAME OF THE CONTRACT: "HIGH-GRADE COPPER"

- CONTRACT MONTHS	The four closest months to the following months: March, May, July, September and December.
- TRADING HOURS	9.25 - 14.00, New York time.
- UNDERLYING ASSET	One COMEX copper futures contract (25 000 pounds).
- MINIMUM PRICE FLUCTUATION	US$0.0005 per pound (= US$12.50 per contract).

- STRIKE PRICE INCREMENTS	One cent per pound for strike prices equal to or below 40 cents, 2 cents per pound for strike prices between 40 cents and US$1, and 5 cents per pound for strike prices above US$1.
- LAST TRADING DAY	Second Friday of the month prior to the delivery month of the underlying futures contract.
- EXERCISE	Until 15.00, New York time, on any business day for which the option is listed for trading.

ANNEX III.1

RELATIONS BETWEEN PRICES CASH, FUTURE, AND CASH EXPECTED

In order to show how future transactions gather together expectations concerning fundamental elements and incorporate them in the cash price, the ratio between the present cash price and the expected cash price is deduced, and it is seen how this ratio passes for the future price.

Equilibrium between the cash and future prices can be brought about by arbitrage.*/ For this purpose, it is advisable to analyse the costs and benefits of fixing the price of the productive input with a certain amount of anticipation, through one of two alternatives: entering into a future contract or acquiring physical inventories and storing them.

1. Relation between future price and cash price

The future contract has (by definition) a zero value at the moment of entering into the future purchase commitment. Therefore, entering into a future contract represents a financial saving with respect to buying inventories. This is a saving of the amount to be paid upon expiration, multiplied by the risk-free rate.**/ In addition, it means saving the storage cost. On the other hand, having the raw material available in physical form has advantages with respect to the future contract. This advantage is called "convenience yield".

The convenience yield is the implicit return that a holder of inventories understands he is receiving from them in the form of security of supply, continuity of compliance with contracts, or advantage being taken of speculative opportunities for sale. This

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*/ An arbitrage operation permits obtaining a benefit without risk, through the cash sale of the product and the simultaneous future purchase, or vice versa. This opportunity exists if the cash prices and future prices differ more than in the sum of net costs or benefits, possessing physical inventories, in relation to possessing contracts for future delivery. At the same time the arbitrage operation tends to eliminate that difference making the price of the cheap asset rise and lowering the price of the expensive asset, thus ensuring the return to equilibrium. Thus, in equilibrium there will not be opportunities for arbitrage, except for small distortions that the more agile operators quickly eliminate.

**/ The price that has to be paid upon expiration is known with certainty, and therefore there is no risk.

factor explains why the holders of inventories tend to maintain them even when they expect the price to go down, or that their possible appreciation will not cover the financial and storage costs.

This relation can be written as:

$$F_0^1 - P_0 = (P_0 \cdot r) + CA - RC$$

in which:

F_0^1 is the future price in 0 for delivery in 1;
P_0 is the cash price in the period 0;
r is the rate of risk-free interest;
CA is the cost of storage; and
RC is the convenience yield.

If this equation is not fulfilled, there would be an opportunity for risk-free arbitrage, either by selling a future contract and buying a spot contract (holding the raw material in an inventory until the maturity of the future contract), or inversely, selling cash and buying future, in order to save the financing and storage costs.

With some simplified assumptions, this relation can be written as:

$$F_0^1 = P_0 \cdot (1 + r - c)$$

in which c is the marginal convenience yield, net of storage costs. The development of this relation is as follows. Let us suppose that the convenience yield, minus the cost of storage, is proportional to the price. This assumption is based on the fact that the convenience yield tends to be high when material is scarce, since, on these occasions, the danger of shortages and opportunities for speculative sales are greater. Of course the price is also higher when there is a shortage, and therefore there is a positive correlation between price and convenience yield. With regard to the cost of storage, in the case of metals, this is relatively low in relation to their value.

A relation that is possible and analytically convenient is one of proportionality. This can be expressed: $RC - CA = c \cdot P$; in

which c is a constant of proportionality, the marginal convenience yield net of storage cost. Then the relation between the cash price and the future price is

$$F_0 = P_0^1 \cdot (1 + r - c)$$

The normal situation is one of spread, that is to say that the future price is higher than the spot price, reflecting the cost of maintaining the commodity in inventories (net of convenience yield, which normally is low), until the moment in which it can be delivered. Within this tendency, the spread varies reflecting changes in its determinants, the cost and advantages of maintaining inventories. If, for example, the cost of money rises, it becomes more expensive to hold inventories, and the spread increases. In times of great scarcity of the physical goods the marginal convenience yield, c, is high, and exceeds the interest rate. The future price, then, is lower than the cash price (a backwardation situation).

2. Future price as estimator of the expected price

Through arbitrage between cashes and futures, the effect of the futures transactions on the cash price is expressed. The argument continues by showing that the future price is nothing more than an estimator (biased) of the expected cash price. Consequently, arbitrage does nothing more than influence the cash price, in order to incorporate the effect of market expectations on the cash price expected later. These expectations, in turn, depend on the information that the market has concerning the probable evolution of the fundamentals.

The future price F_0^1 is a biased estimator of P_1, the cash price in the period 1, since short coverages tend to predominate over long ones in the markets and thus speculators must be stimulated to take the risk involved in buying future contracts. This relation can be written as follows:*/

$$E[P_1] = F_0^1 [1 + PR]$$

This formula develops as follows. Speculators require a premium PR for the systematic risk of the future contract. On the other hand, the expected return in cash of a long position in a future contract is $E[R\$] = E[P_1] - F_0^1$.

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*/ This is the hypothesis of net pressure of short coverage, that corresponds to the situation designated by Keynes as "normal backwardation" (1930).

In order that speculators may be disposed to take futures contracts in excess of supply, the expected return in cash E[R$] must cover the premium required for the risk PR. But it cannot be higher, because then this would produce an excess of speculative demand. Therefore PR = E[R$], which implies $E[P_1] = F_0^1 \cdot (1 + PR)$. This demonstrates that the future price is an unbiased estimate of the cash price, in the future, for the amount of the premium for risk.

Combining this relation and that of arbitrage deduced above, leads to equilibrium between the cash price and the expected price:

$$P_0 = E(P_1)/(1 - r + c - PR)$$

It is concluded then that the exchanges are a mechanism which permits incorporating in the cash price the market expectations concerning the probable evolution of the price. In the markets where producers prices predominate, these are incorporated only in the producers expectations. In fact, in the producers price scheme the price is modified only when sufficient information is accumulated so that producers may decide that at this price there is an imbalance between production and consumption, present or expected for the future, and thus producers prices tend to reflect a longer term vision (Díaz-Alejandro, 1979). On the other hand, expectations of other agents are likewise expressed in the exchanges: consumers and investors.

ANNEX III.2

OPTIONS

1. Terminal value of an option

The terminal value of an option is the maximum between zero and the difference between the underlying asset price and the exercise price. If we call S the price of the underlying asset, C the value (premium) of the purchase option and P the value of a sale action, then:

$$C = \max \{0, S-K\}; \text{ and}$$
$$P = \max \{0, K-S\}$$

The terminal value of the option is called intrinsic value. Before its expiration, the option has an additional value, called "time value" or "extrinsic value". This additional value is due to the fact that, while the option is, for example, momentarily "out of the money", there are probabilities that the asset price may move in such a way that at the expiration of the option it becomes "in the money". Therefore investors give it a positive value. The greater the price volatility of an underlying asset, and the longer the time remaining until the expiration of the option, the greater the possibilities that this may occur. Therefore the time value of the option grows with volatility and the time remaining until expiration.*/

2. Method of valuation through a replication portfolio

The Black and Scholes formula is used for appraising an option. This formula is derived from the replication of the value of an option through a portfolio of the underlying asset and debt.

Let us take a simple case where the underlying asset, say a petroleum share or future contract, can take on only two values in the next period: if its present price is 100, the price of the next period can be 50 or 150.

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*/ Options transacted on exchanges have a secondary market. Consequently, instead of exercising the option, it is possible to resell it in this market. This is important for "American" options (which can be exercised before the expiration date). In fact, an American option "out of the money" has an exercise value of zero but a resale value that is, in general, positive, due to the possibility that, on the expiration date, it might by then be "in the money".

Let us take a call option underwritten in the money, that is to say its exercise price in the moment of underwriting is also 100. In the next period, this option will take on a maximum value between zero and the difference between the price of the asset and the exercise price, that is to say, 0 if the price of the asset is 50, or 50 if the price of the asset is 150.

In order to replicate this option with a portfolio of the assets and risk-free bonds, the portfolio and the option must have the same value in any circumstance. The terminal values, then, are equal:

$$\hat{A} \cdot S_1 + (1+r) \cdot B = C_1$$

in which $\hat{A}$ is the number of units of the asset in the portfolio, S_1 is the price of the asset, B is the number of risk-free unit bonds in the portfolio, r is the rate of interest (risk-free) that they earn, and C_1 is the value of the option.

For our numerical example, if r is 8.7% it must follow that:

$\hat{A} \cdot 150 + 1{,}087 \cdot B = 50$ when the price S rises to 150;
and $\hat{A} \cdot 50 + 1{,}087 \cdot B = 0$ when the price S falls to 50.

With these two equations, the values of the two unknowns are obtained and are:

$$\hat{A} = 1/2$$
$$B = -25/1{,}087 = 23$$

The present value of this portfolio is consequently:

$$\hat{A} \cdot 100 + B = 1/2 \cdot 100 - 23 = 27$$

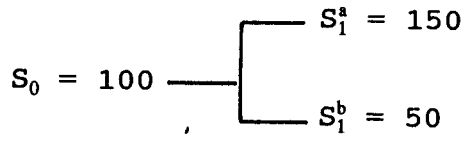
Therefore the present value of the option is $C_0 = 27$.

In the section that follows, it is presented with this valuation, as well as the extension to an option with a two-period duration.

3. Valuation of a binomial option: numerical example

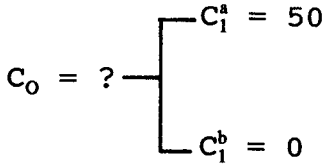
a) Option of a one-period duration

Price process

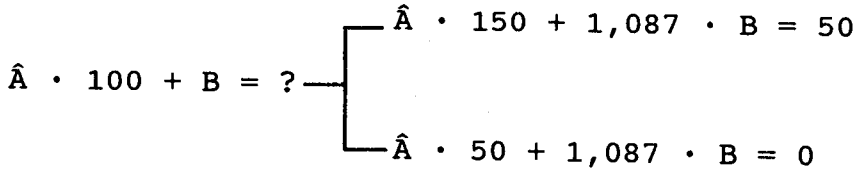


Value of the option:

at the end of period $C = \text{Max}\ \{0,\ P - K\}$, with $K = 100$:



Value of the replication portfolio:



Solution:

$$\hat{A} = 1/2$$
$$B = -25/1{,}087 = 23$$

Therefore the present value of this portfolio is:

$$\hat{A} \cdot 100 + B = 1/2 \cdot 100 - 23 = 27$$

and the value of the option is $C = 27$.

b) Valuation of an option of a two period duration

Let us take a slightly more complex option, which covers two periods. Like the previous one, it has an exercise price of 100, the initial price of the asset likewise being 100, and the price can rise, multiplying it by 1,5, or fall, multiplying it by 0,5. If the price at the end of the first period is 150, then at the end of

the second period it can reach 225 or 75. If it was 50, it can reach 75 or 25.

Let us value this option starting at the end, when some time is left before expiration. Let us take first the case where the price rose to 150. The value of the option at the end of the second period would be 125, if the price of the asset rises to 225, or zero, if the price of the asset falls to 75. Therefore at the end of the second period:

$$\hat{A}^a \cdot 225 + (1+0,087)^2 \cdot B^a = 125$$

$$\hat{A}^a \cdot 75 + (1+0,087)^2 \cdot B^a = 0$$

This system gives the following values for the composition of the portfolio at the end of the first period:

$$\hat{A}^a = 125/150 = 5/6 = 0,83$$
$$B^a = 125/2 \cdot 1,087^2 = -53$$

The value of the portfolio at the end of the first period is:

$$\hat{A}^a \cdot 150 + (1+r) \cdot B^a = 0,83 \cdot 150 - 1,087 \cdot 53 \tilde{} 67,5$$

Therefore the value of the option is:

$$C_1^a = 67,5.$$

The same exercise for a price of 50 at the end of the first period gives:

$$\hat{A}^b \cdot 75 + (1+0,087)^2 \cdot B^a = 0$$
$$\hat{A}^b \cdot 25 + (1+0,087)^2 \cdot B^b = 0$$

This system gives the following values for the composition of the portfolio at the end of the first period:

$$A^b = 0$$
$$B^b = 0$$

The portfolio's value at the end of the first period is zero, and therefore the value of the option C_1^b is zero. This is reasonable, since there is no probability at all that it may reach a positive terminal value.

Now let us go back a period. At the end of period one the option can be worth $C_1^a = 67,5$ or $C_1^b = 0$ according to whether the price rises from 100 to 150 or falls to 50. Then:

$$\hat{A} \cdot S_1 + (1+r) \cdot B = C_1$$

$\hat{A} \cdot 150 + 1{,}087 \cdot B = 67{,}5$ when the price rises to 150;
and $\hat{A} \cdot 50 + 1{,}087 \cdot B = 0$ when the price falls to 50.

The result is:

$\hat{A} = 0{,}675$
$B = -67{,}5/2 \cdot 1{,}087 \approx -31$

The present value of this portfolio is:

$$\hat{A} \cdot 100 + B = 0{,}675 \cdot 100 - 31 = 36{,}5$$

Therefore the value of the option is $C_0 = 36{,}5$. Note that this option with the duration of two periods has a value higher than the identical option that lasts only one period, and that we calculated was worth 27.

Finally, let us verify that the dynamic portfolio is self-financing. If the price rises from 100 to 150, the portfolio is changed from $A = 0{,}675$ to $\hat{A}^a = 0{,}833$, which requires an expenditure of $(\hat{A}^a - \hat{A}) \cdot 150 \approx 23{,}7$, which is financed with greater indebtedness of $(B^a - B) \cdot (1+r) = (-53+31) \cdot 1{,}087 = -22 \cdot 1{,}087 \approx -23{,}9$.

If, on the contrary, the price drops to 50, the portfolio is changed from $\hat{A} = 0{,}675$ to $\hat{A}^b = 0$, which gives an income of $(\hat{A}^b - \hat{A}) \cdot 50 \approx 33{,}75$, which permits repaying the debt of $B \cdot (1+r) = 31 \cdot 1{,}087 \approx -33{,}7$. In this case the portfolio has no value.

ANNEX IV.1

EFFICIENCY OF THE METALS EXCHANGES

The weak form of efficiency is that where prices incorporate all past market information. The semi-strong form of efficiency is that where the price incorporates all the published information available whether on the past or the future market. Strong efficiency is that where the price reflects all public and private information, and no one can earn an excessively high profit using public or private information.*/

1. The price incorporates all past information

The result of having prices incorporate all past market information is that it becomes impossible to obtain an additional profit by operating only on the basis of the history of past prices. If this is the case, then the price describes an aleatory path, which means that the magnitude and direction of the percentage changes in the prices are independent of changes that occurred in the past.

The classic argument in favour of the aleatory path thesis is that prices depend on expectations concerning the future price level and events that affect it. New information changes the expectations of investors and speculators, who take the corresponding action, with prices responding rapidly. If the information reaches the market in an aleatory way, then the price response to the new information occurs in the same way.

On the other hand, if the information would arrive in a discernable profile, then the operators would discover it and could benefit from such knowledge. However, when exchange operators and speculators all take the same action at the same time, opportunities to make a profit disappear rapidly, destroying whatever recognizable price movement profile might have existed. If this would not occur, there would still be opportunities for profitable business for those with greater analytical abilities or better sources of information.

An attempt has been made to evaluate the weak form of efficiency in metals markets through attempts at self-correlation and test runs. There is evidence that metals prices show positive self-correlation. Therefore, they do not follow a totally aleatory path. It has been demonstrated that it is possible to construct an

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*/ See Lorie and Hamilton (1973), chapter 4 for their historic account of the aleatory change hypothesis, as well as proof of the hypothesis.

exchange strategy which, at least on paper, would have produced profits. However, if transaction costs are considered, it is not clear that it would have been possible to obtain profits. If it were thus, it would mean that there is no attraction sufficient for taking action, correcting along the way this recognizable price-movement profile. For all practical purposes, this would be an approximation to an aleatory path (Humphreys, 1987).

Another focus for proving weak efficiency is the test to determine how good a predictor a present future price is of the future cash price. The idea is that if new developments are aleatory, then the "prediction error" measured as the difference that is produced between the predictor (the present future price) and the realization, must be aleatory (B. A. Goss, 1986, cited by Humphreys, 1987). The result of this proof was that, for copper, tin and lead it is not possible to reject the efficiency hypothesis, and for zinc the result was inconclusive. Strictly speaking, it is necessary to wait for a bias equal to the premium for the systematic risk of taking a position in a future contract. To the extent that this premium might not be constant over time, the test can have a negative result, even though the market would be efficient. Through the application of a statistical technique that considers this criticism, it has been found, in applications to copper and lead, that it is not possible to reject the efficiency hypothesis (McDonald and Taylor, soon to appear, cited by Hallwood, 1988).

In conclusion, there seems to be evidence of inefficiency in the metals markets, but not sufficiently severe to reject the aleatory path hypothesis.

2. Prices reflect all public information

In order to prove the semi-strong efficiency form, it has been verified that all information contained in the price structure for a metal is already contained in the price structure of the others. Thus, it would be demonstrated that all information publicly available has already been used. The test consists of verifying whether the "prediction error" for a metal, as defined above, has a nil correlation with the prediction error of another metal transacted on the same exchange and presumed to share the same sources of information. The result was that the copper and zinc markets are inefficient in a semi-strong way, but the author indicates that the result may be due to inefficiencies in the information market, that is to say, that some data might be more public than others (B. A. Goss, 1986). On the other hand, the semi-strong efficiency hypothesis is accepted for tin and lead.

Another way of proving the semi-strong deficiency is by comparing the predictive ability of an econometric model with that of the future price. If the model is consistently a better

predictor, it means that the market (the future price) is not using efficiently all the information publicly available. In applying this to the tin market for the period 1968-1978, it was found that the model was a better predictor (Brasse, 1986, cited by Humphreys, 1987). In an application of the test to the copper and aluminum markets, it was found that the models do not prognosticate better than the futures prices, and therefore it was not possible to reject the semi-strong efficiency hypothesis (Martin Gross, 1988).

3. Private information

The strong form of efficiency is that where the price incorporates even information that is not public but is available to some agents. In a study by the Commodity Futures Trading Commission of the United States it was concluded that there was not sufficient evidence of "insider trading" occurring, that is to say, illegal use of private information (CFTC, 1984). To the best of our knowledge, tests of the strong efficiency in the metals market have not yet been made.

ANNEX IV.2

VOLATILITY OF METALS PRICES

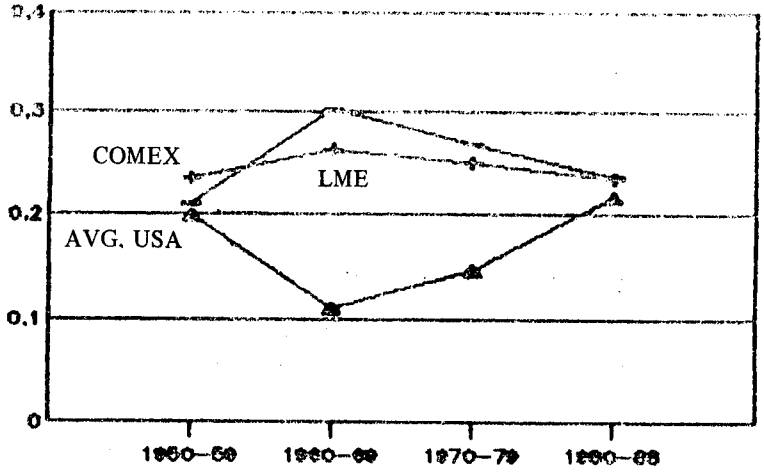
GRAPHS OF:

COEFFICIENTS OF VARIATION OF EXCHANGE PRICES AND PRODUCERS PRICES
- By decades
- Annually

AVERAGES ANNUAL PRICES, VERSUS MONTHLY, OF THE PRINCIPAL EXCHANGES
- These are real prices, deflated by the W.P.I. deflators. United States (1975=100), which appear in table II.27.

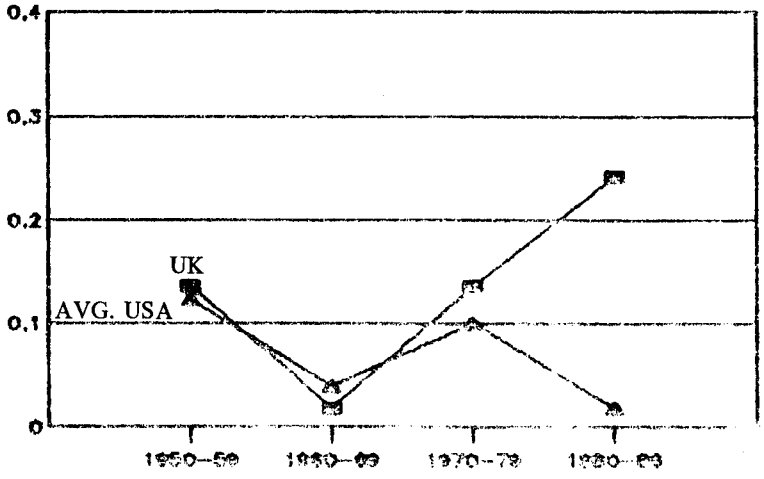
COPPER

COEFFICIENTS OF VARIATION



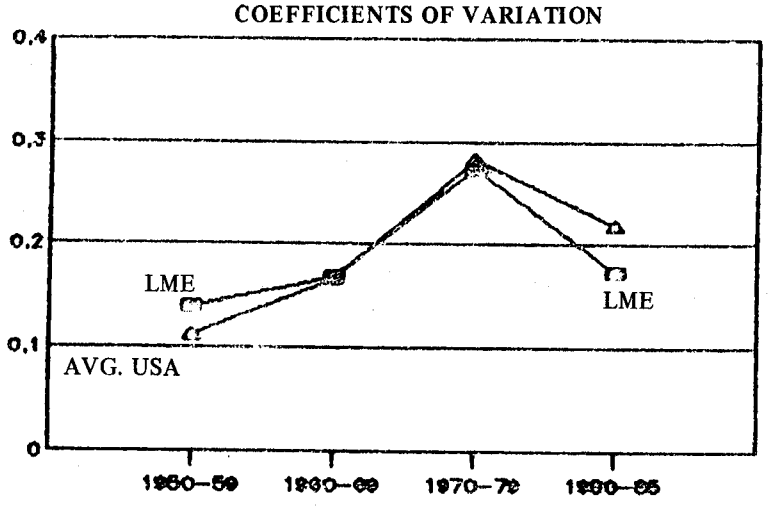
ALUMINUM

COEFFICIENTS OF VARIATION



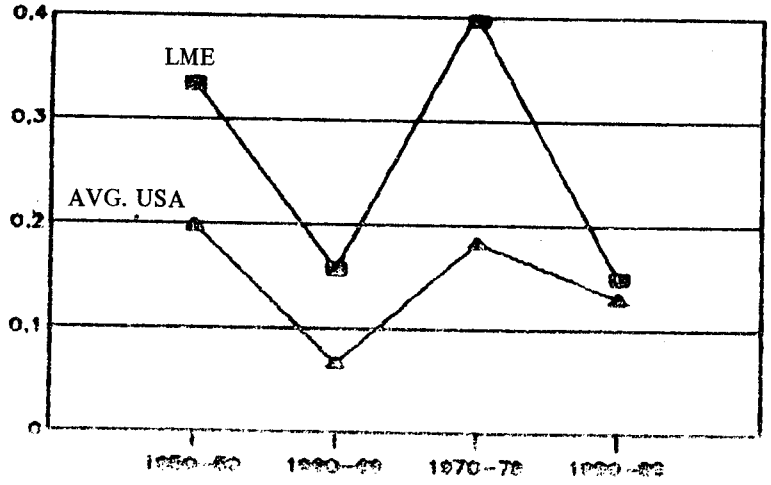
TIN

COEFFICIENTS OF VARIATION



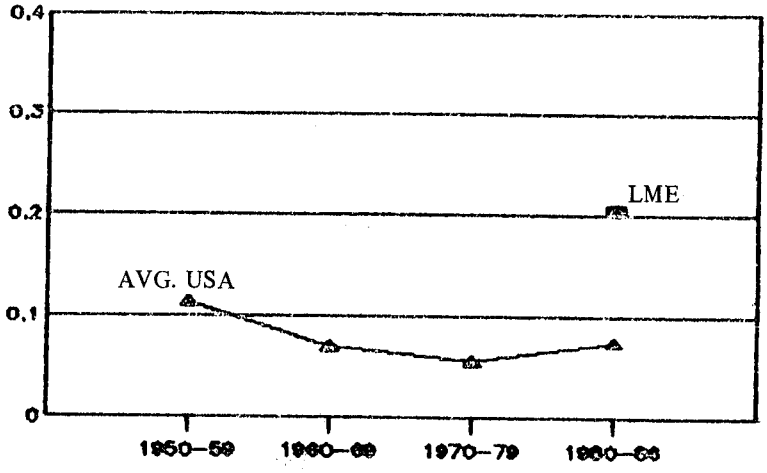
ZINC

COEFFICIENTS OF VARIATION



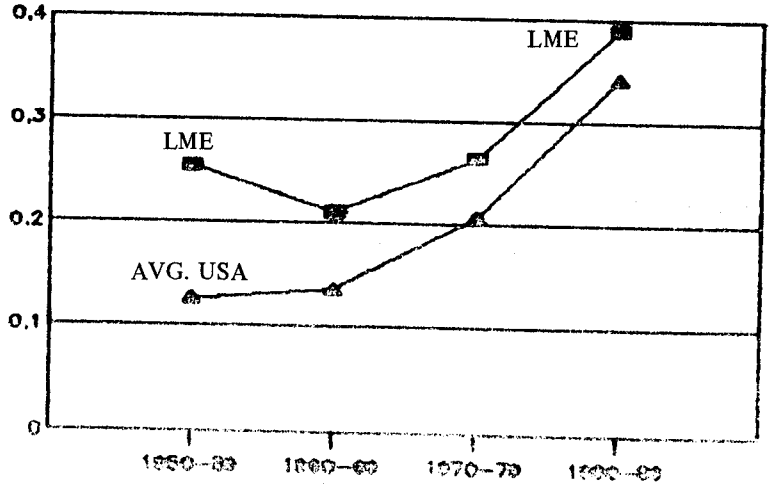
NICKEL

COEFFICIENTS OF VARIATION



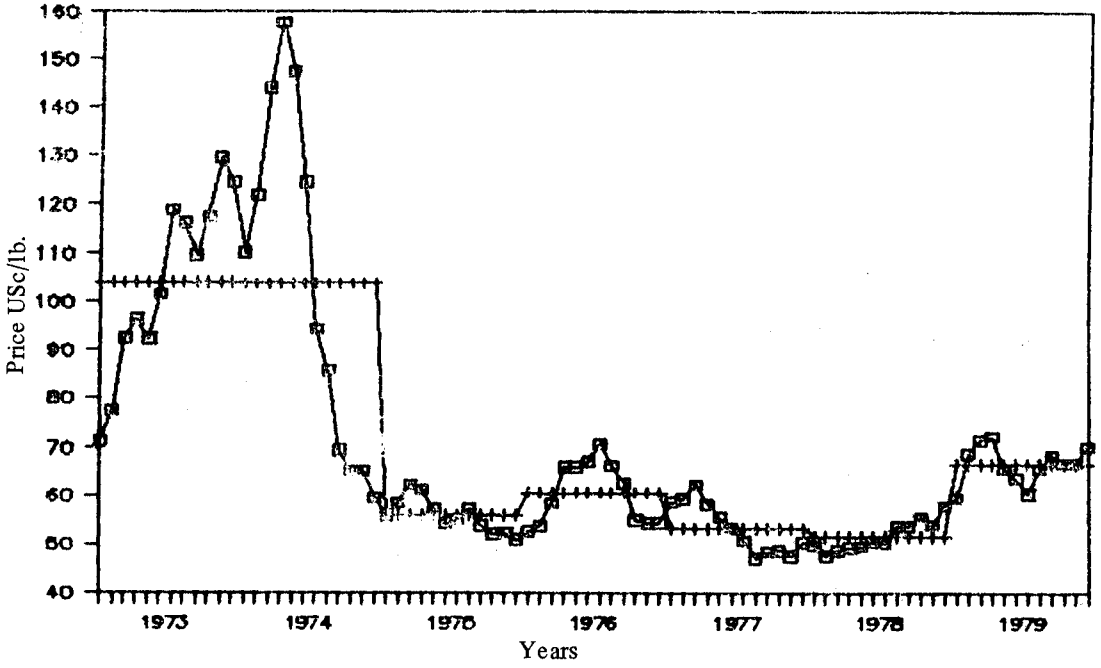
LEAD

COEFFICIENTS OF VARIATION



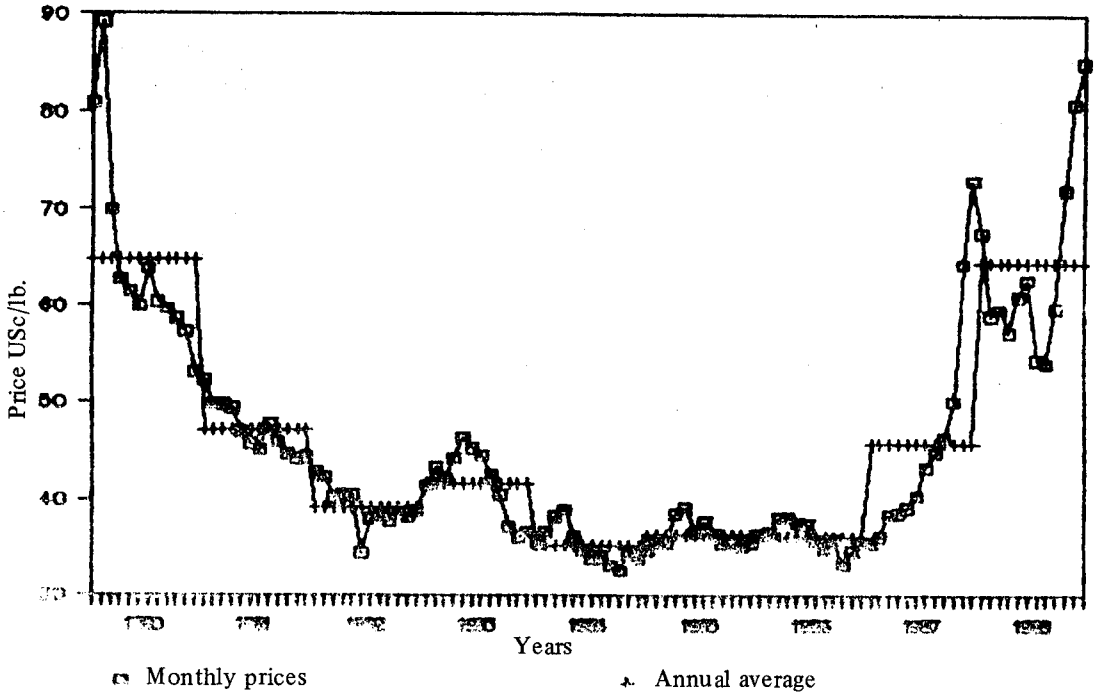
COPPER L.M.E.

RATIO MONTHLY PRICE-ANNUAL AVERAGE



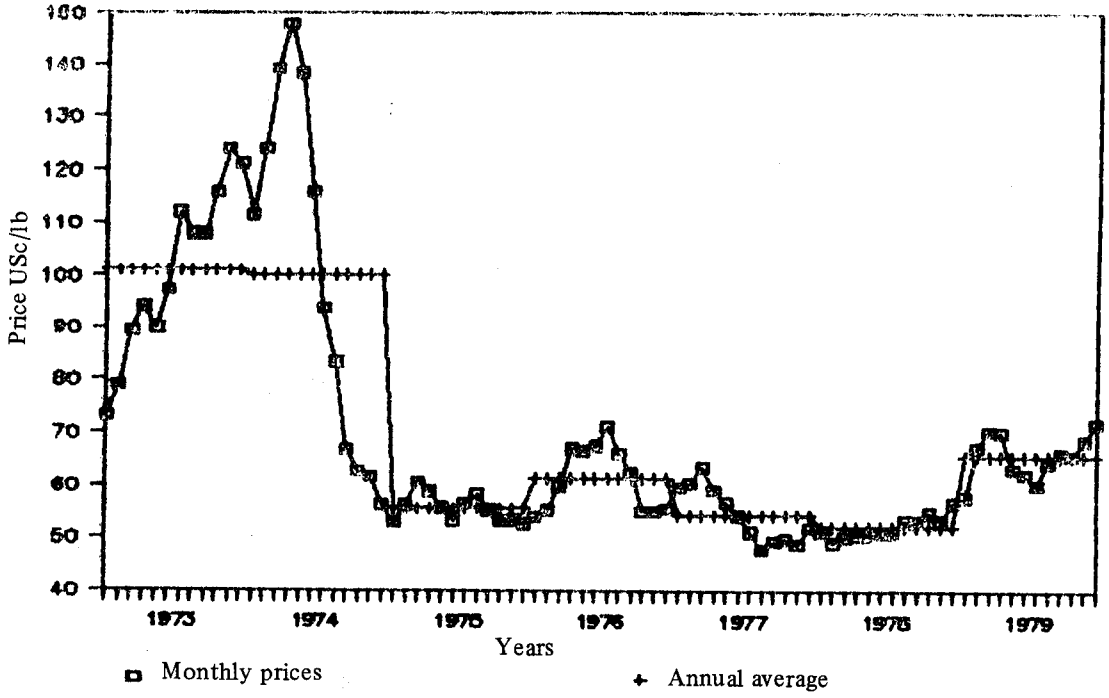
COPPER L.M.E.

RATIO MONTHLY PRICE-ANNUAL AVERAGE



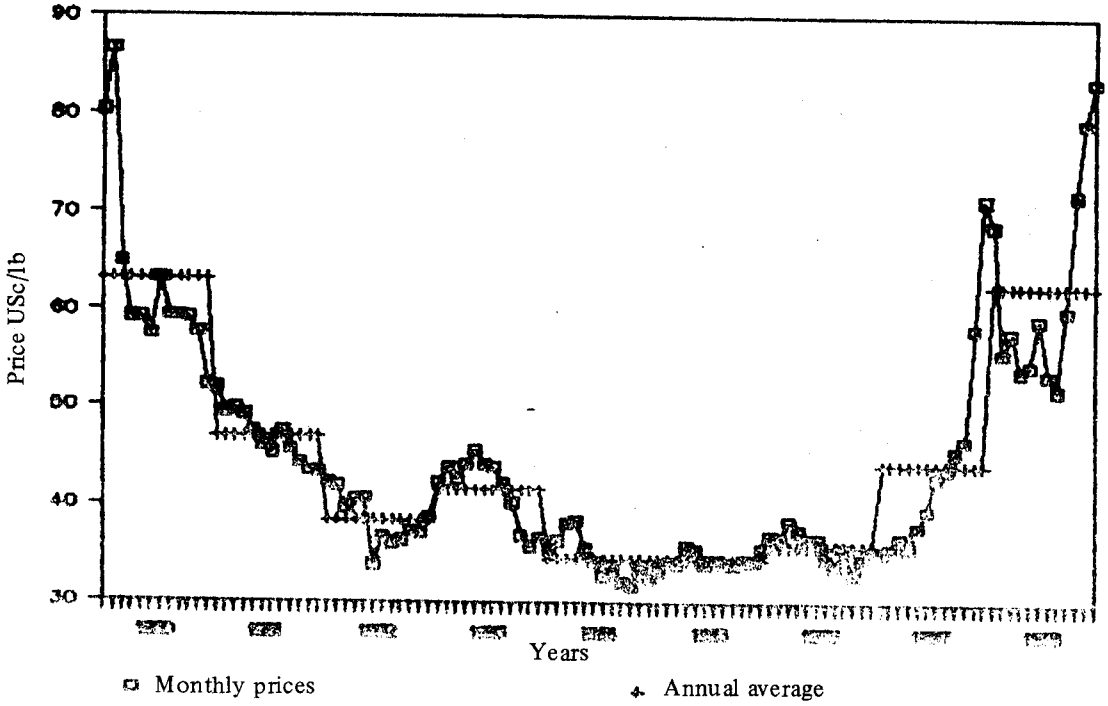
COPPER COMEX

RATIO MONTHLY PRICE–ANNUAL AVERAGE



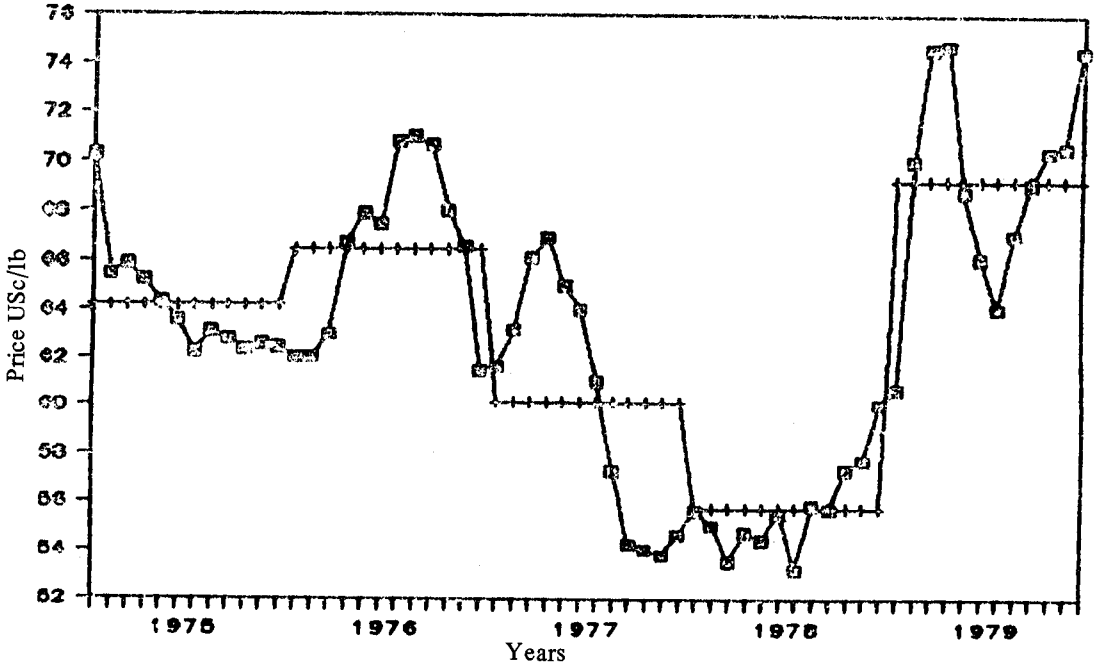
COPPER COMEX

RATIO MONTHLY PRICE–ANNUAL AVERAGE



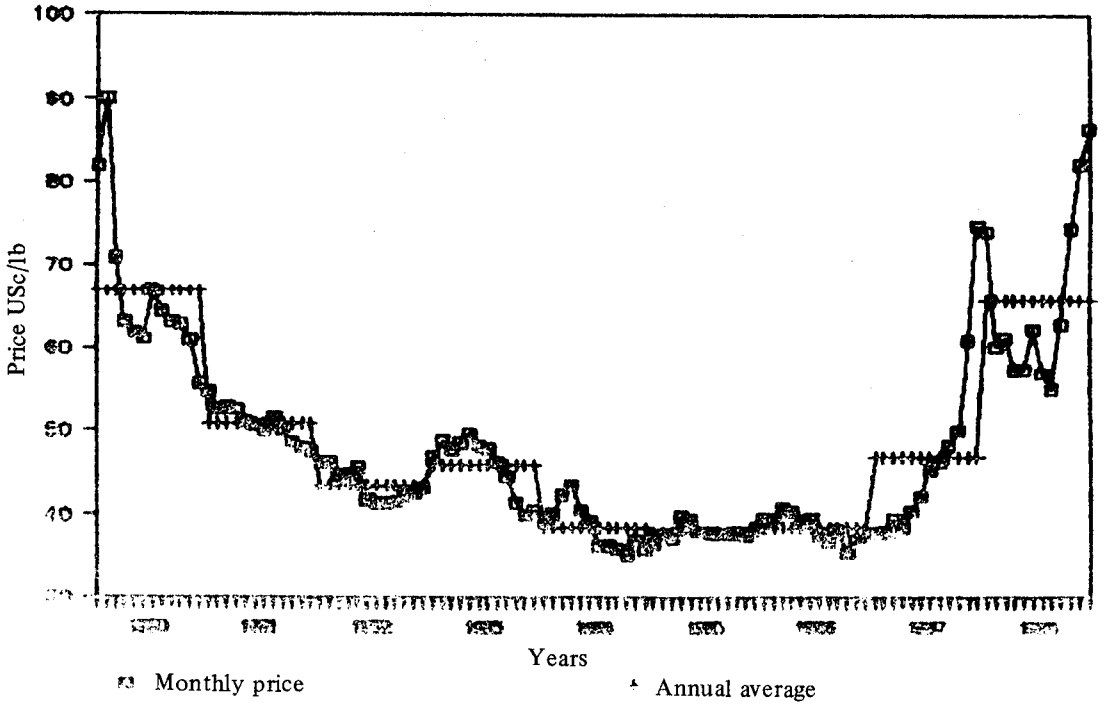
COPPER PROD. USA

RATIO MONTHLY PRICE–ANNUAL AVERAGE



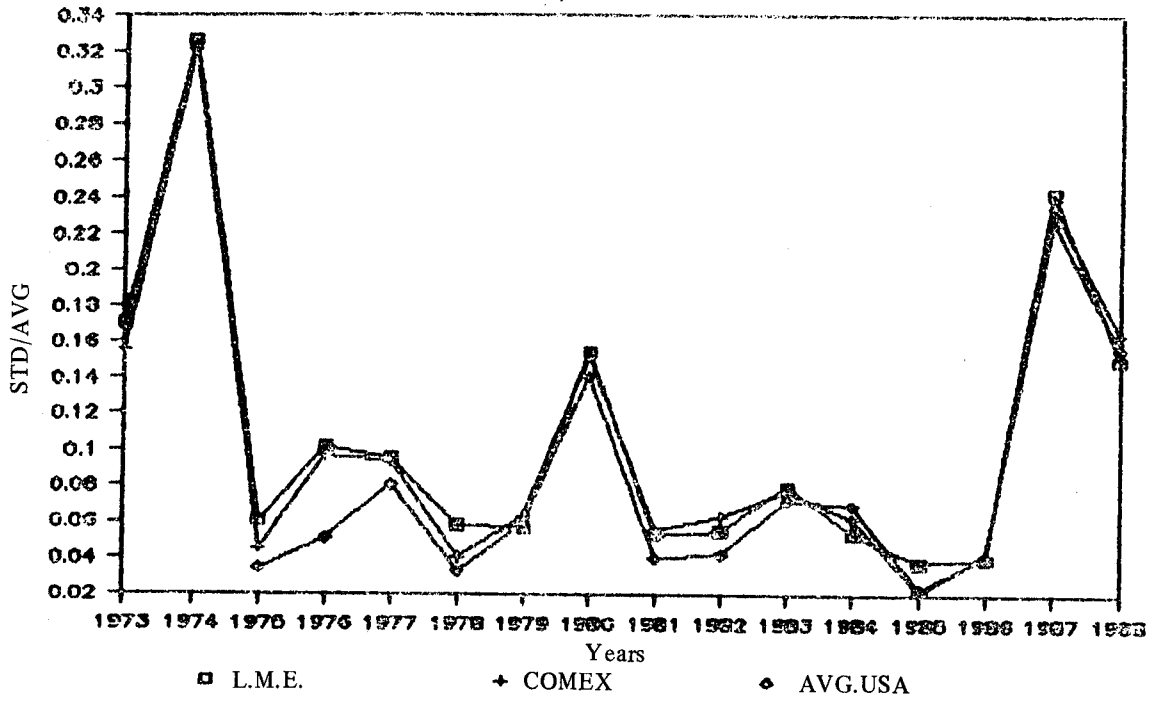
COPPER PROD. USA

RATIO MONTHLY PRICE – ANNUAL AVERAGE



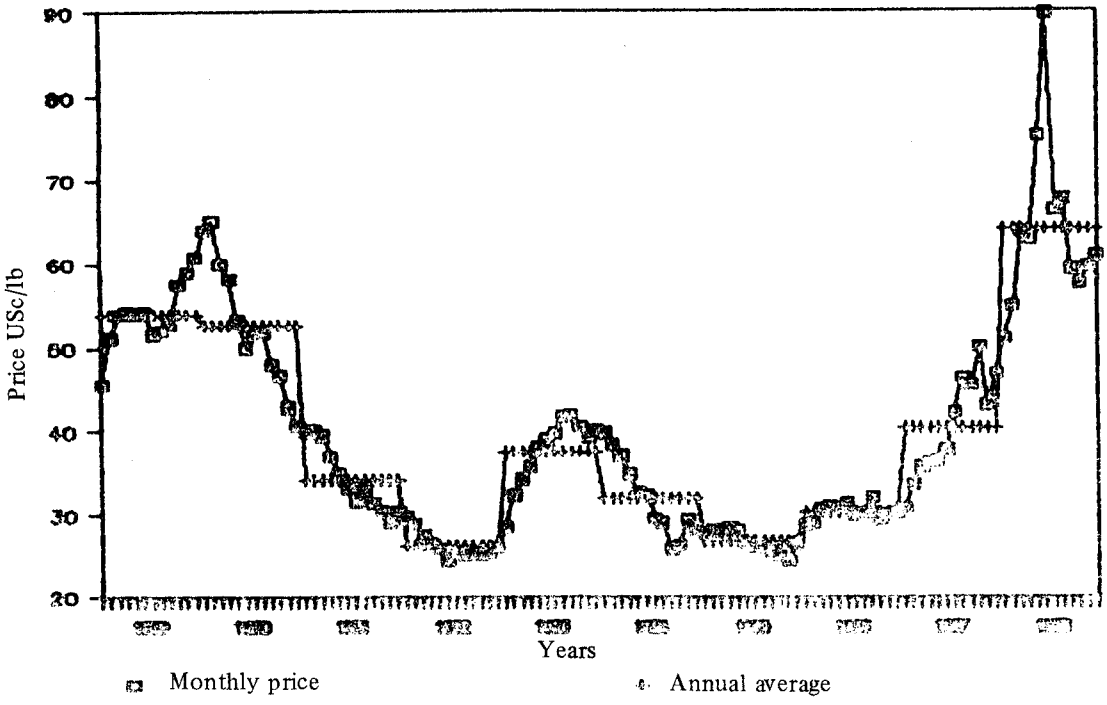
ANNUAL PRICE COPPER

RATIO STD/AVG BETWEEN EXCHANGES



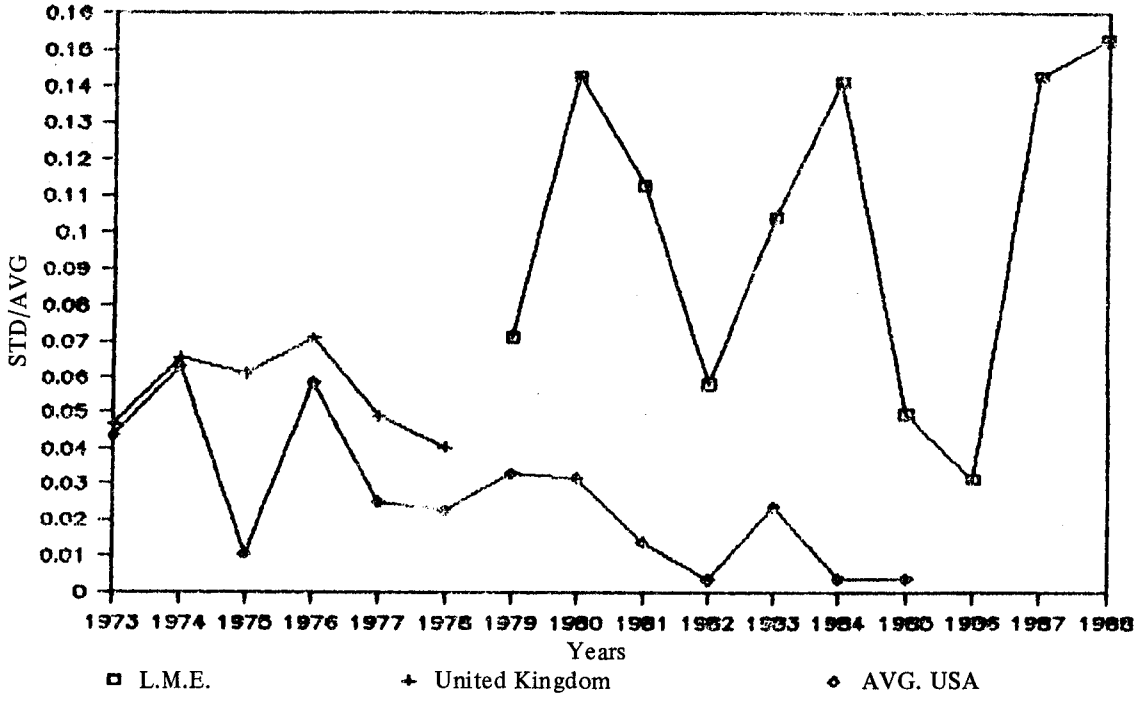
ALUMINUM L.M.E.

RATIO MONTHLY PRICE–ANNUAL AVERAGE



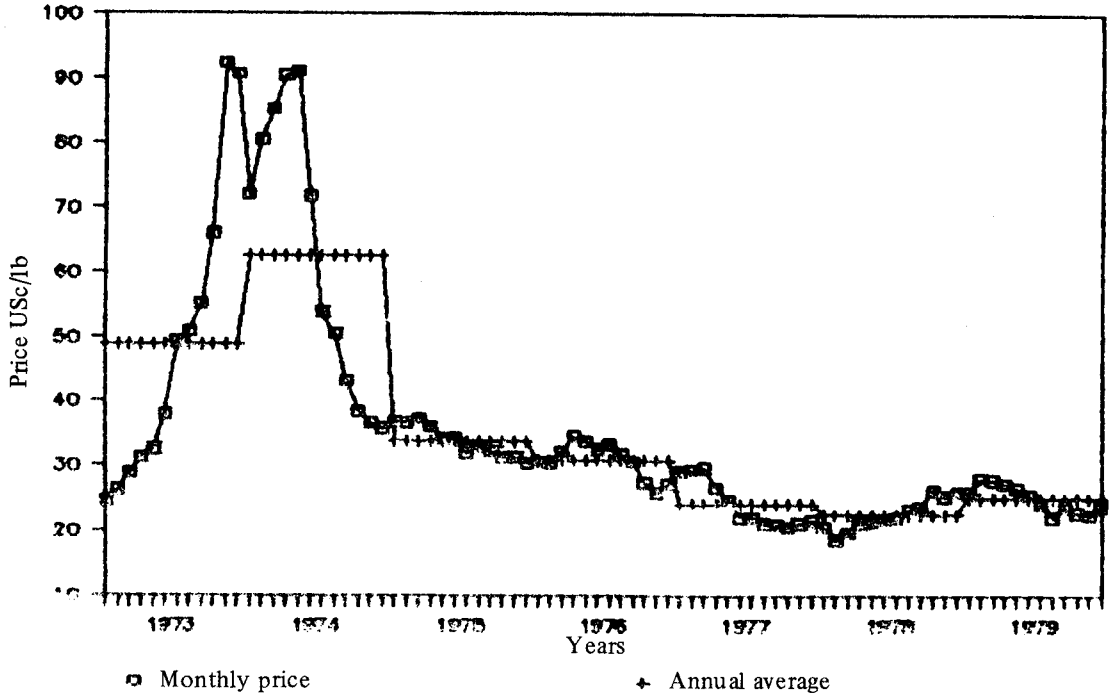
ANNUAL PRICE–ALUMINUM

RATIO STD/AVG BETWEEN EXCHANGES



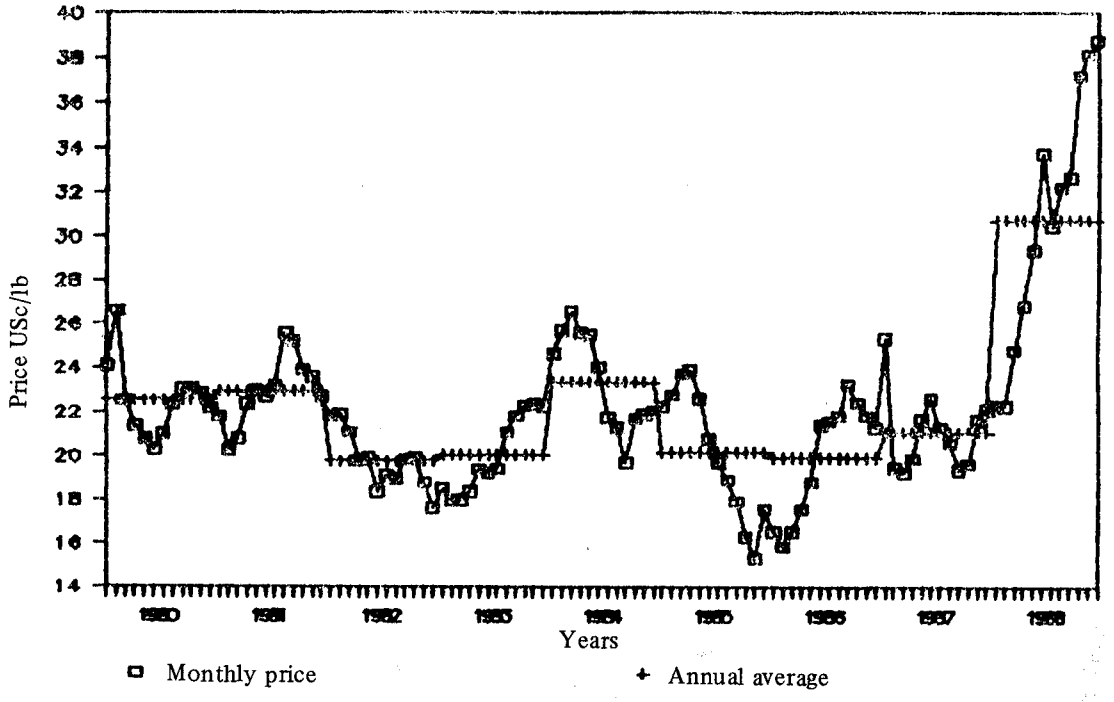
ZINC L.M.E.

RATIO MONTHLY PRICE–ANNUAL AVERAGE



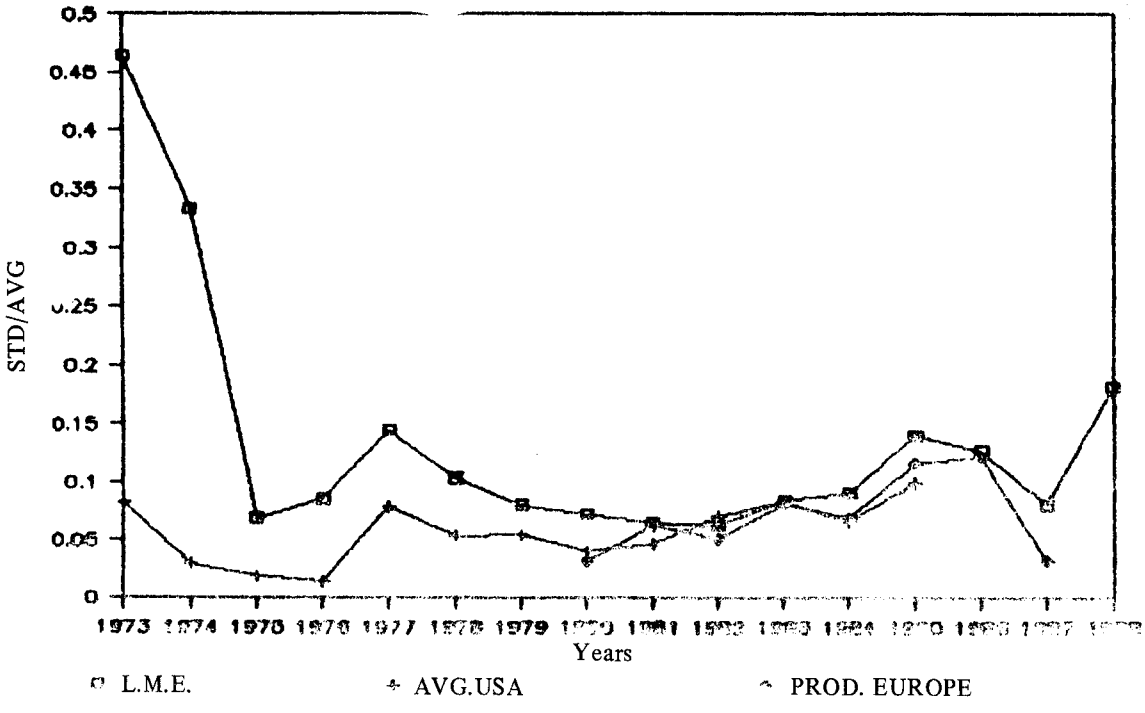
ZINC L.M.E.

RATIO MONTHLY PRICE–ANNUAL AVERAGE



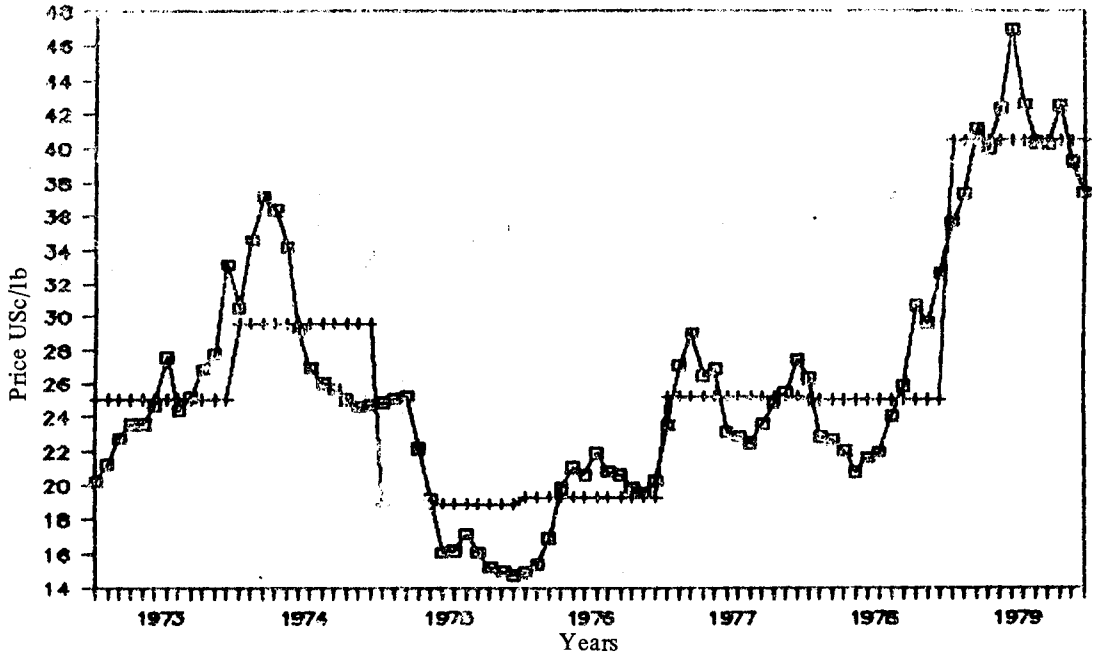
ANNUAL PRICE ZINC

RATIO STD/AVG BETWEEN EXCHANGES



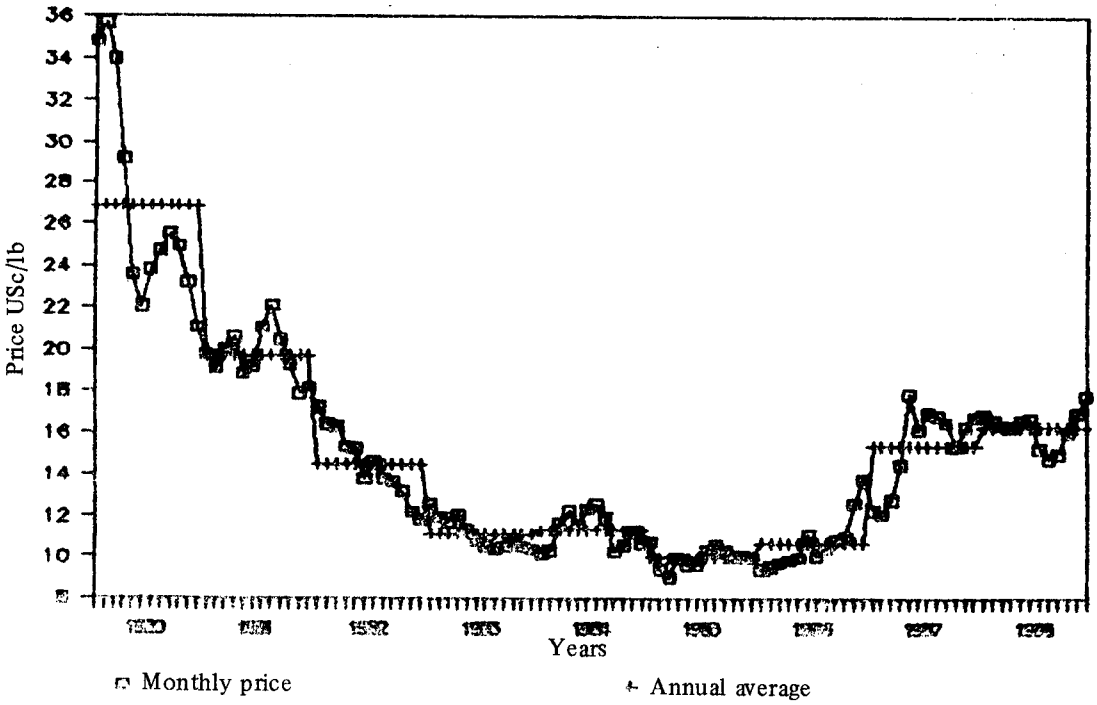
LEAD L.M.E.

RATIO MONTHLY PRICE–ANNUAL AVERAGE



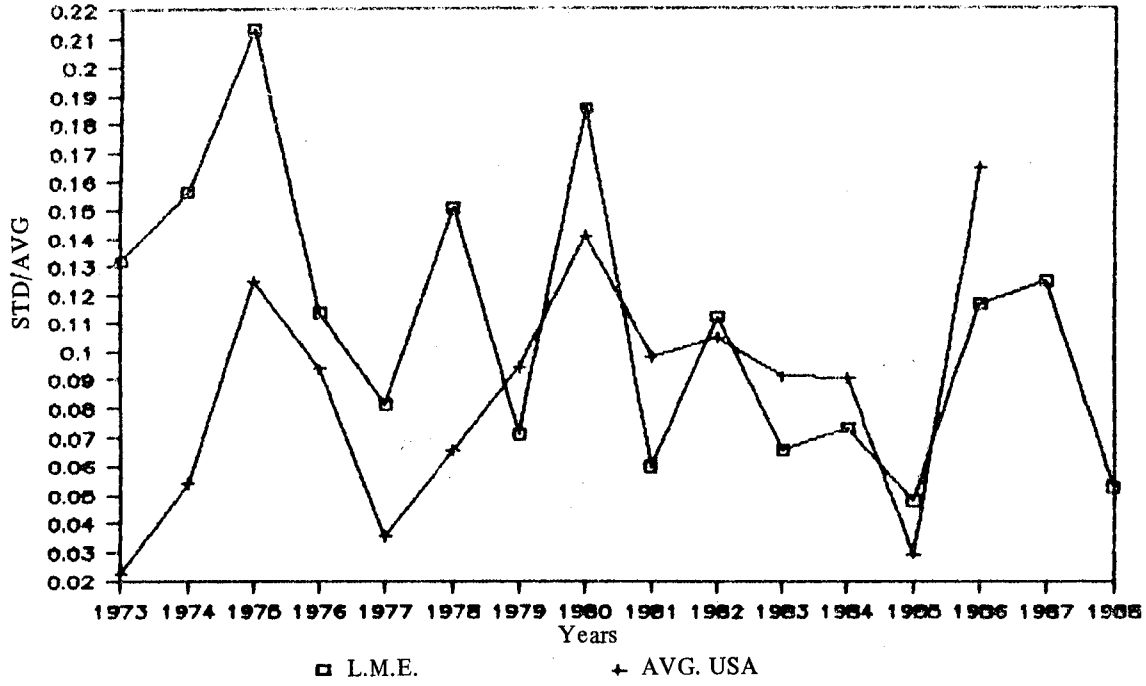
LEAD L.M.E.

RATIO MONTHLY PRICE–ANNUAL AVERAGE



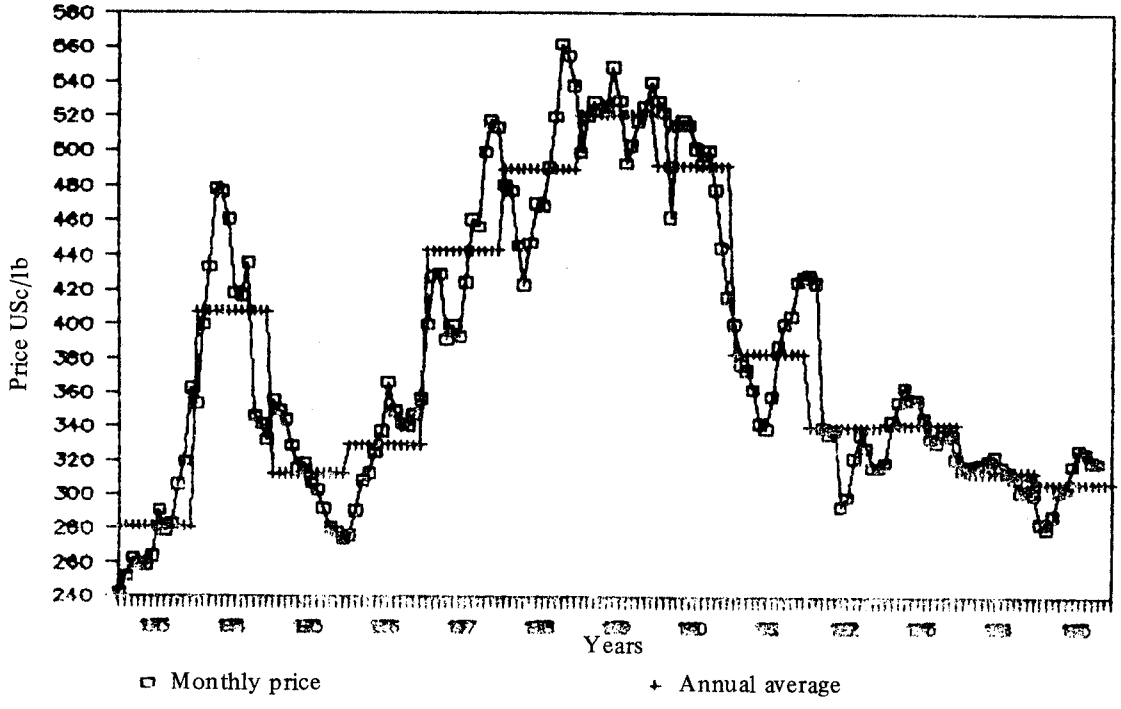
ANNUAL PRICE LEAD

RATIO STD/AVG BETWEEN EXCHANGES



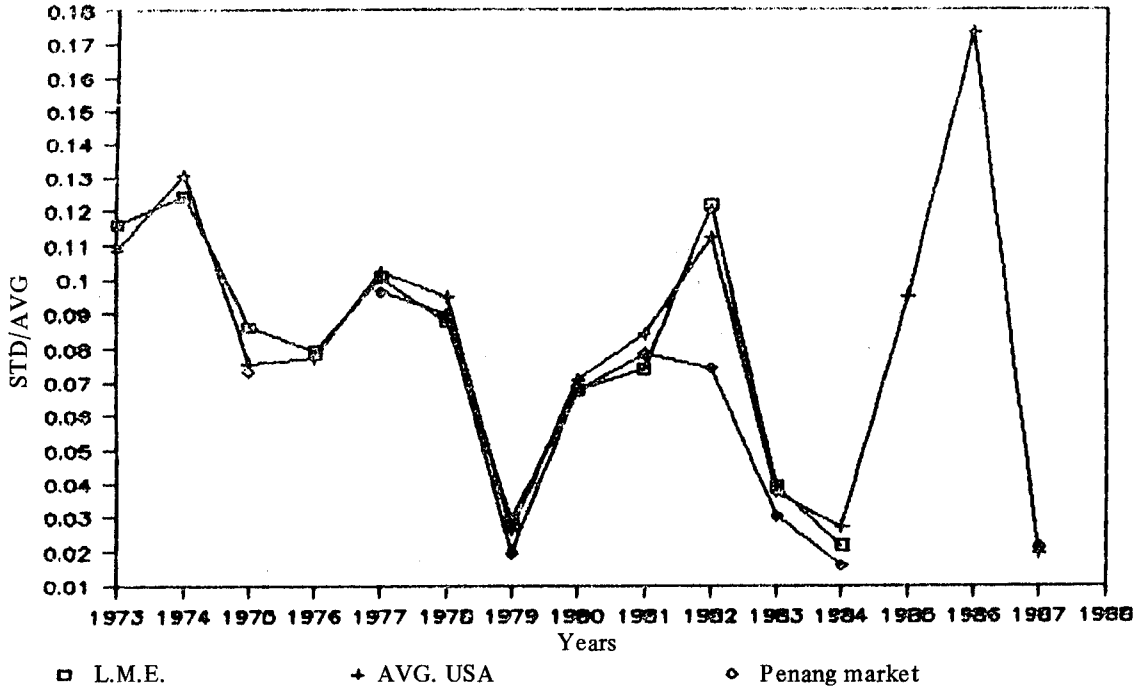
TIN L.M.E.

RATIO MONTHLY PRICE–ANNUAL AVERAGE



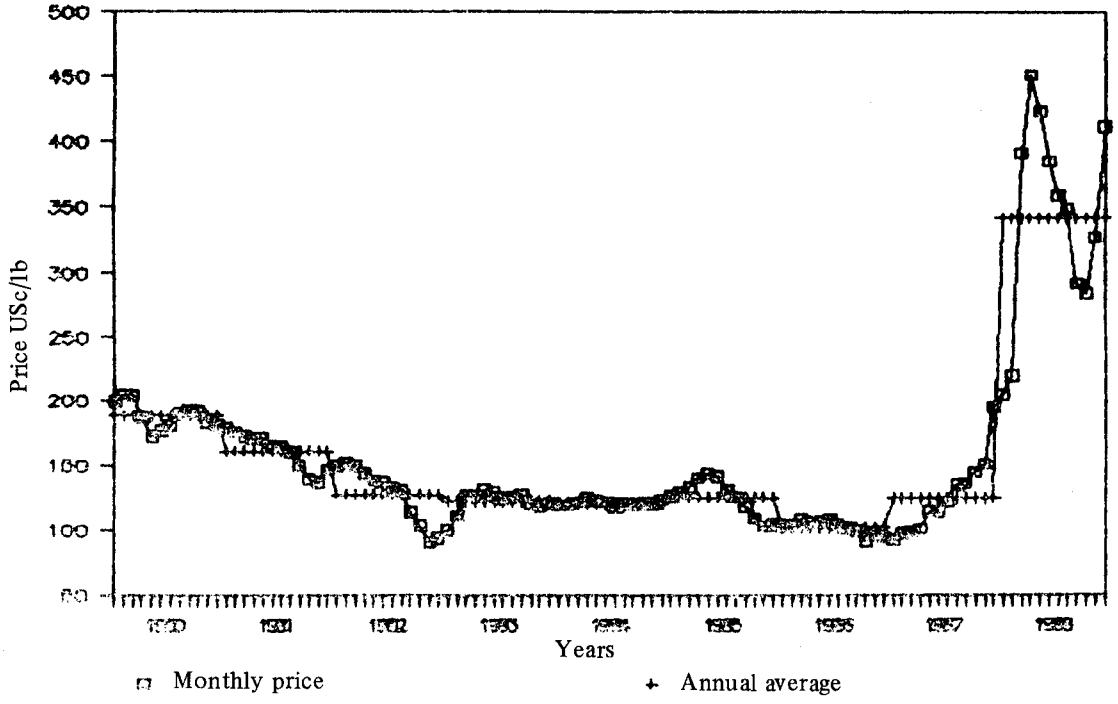
ANNUAL PRICE TIN

RATIO STD/AVG BETWEEN EXCHANGES



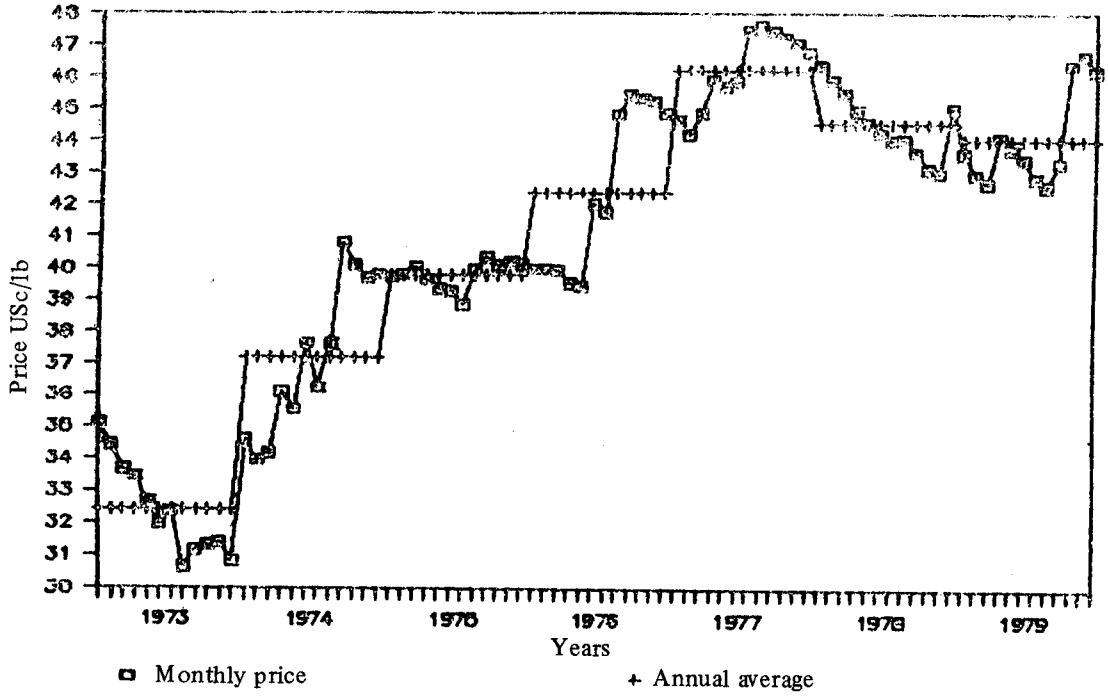
NICKEL L.M.E.

RATIO MONTHLY PRICE–ANNUAL AVERAGE



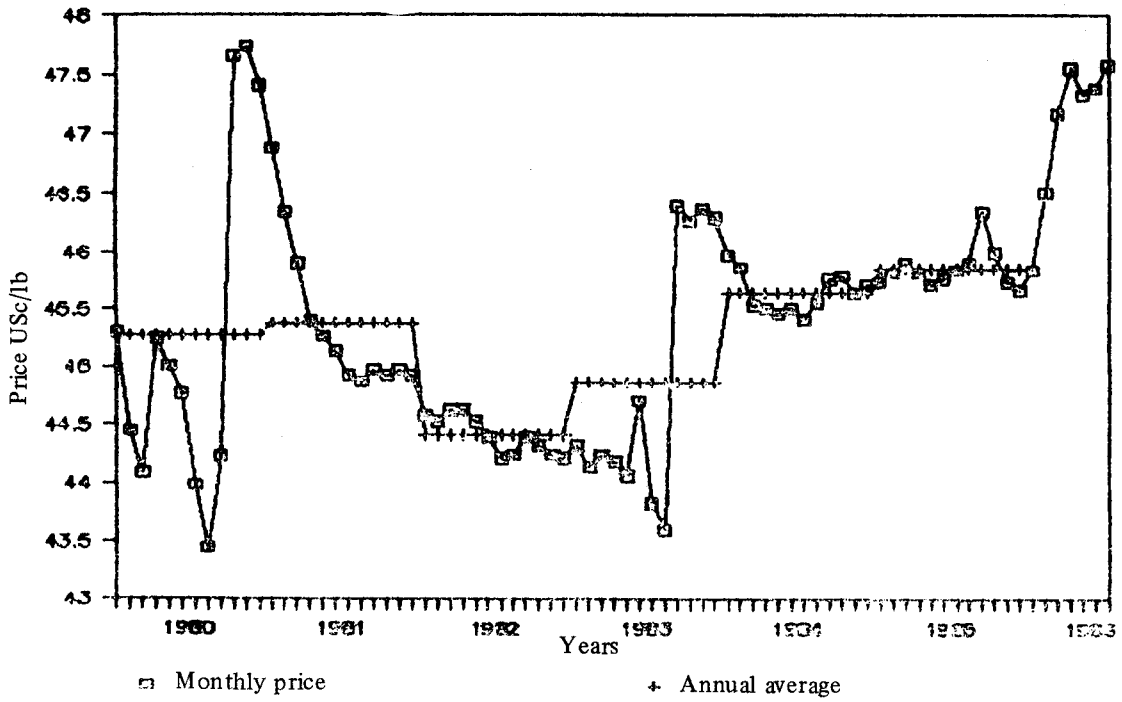
ALUMINUM PROD. USA

RATIO MONTHLY PRICE–ANNUAL AVERAGE



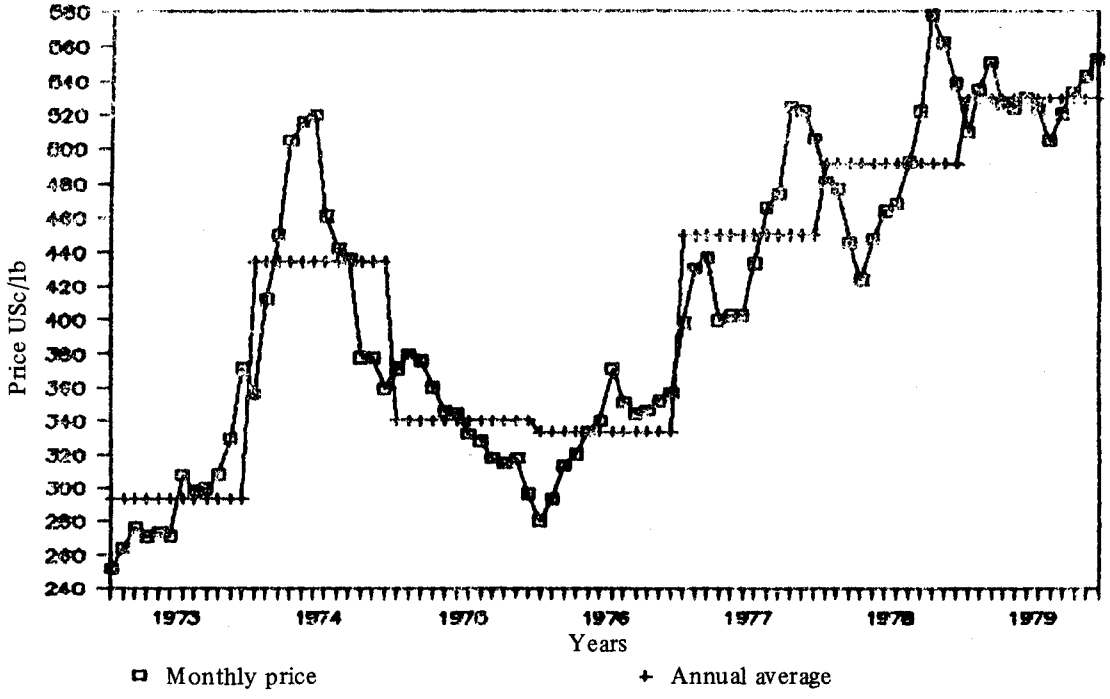
ALUMINUM PROD. USA

RATIO MONTHLY PRICE–ANNUAL AVERAGE



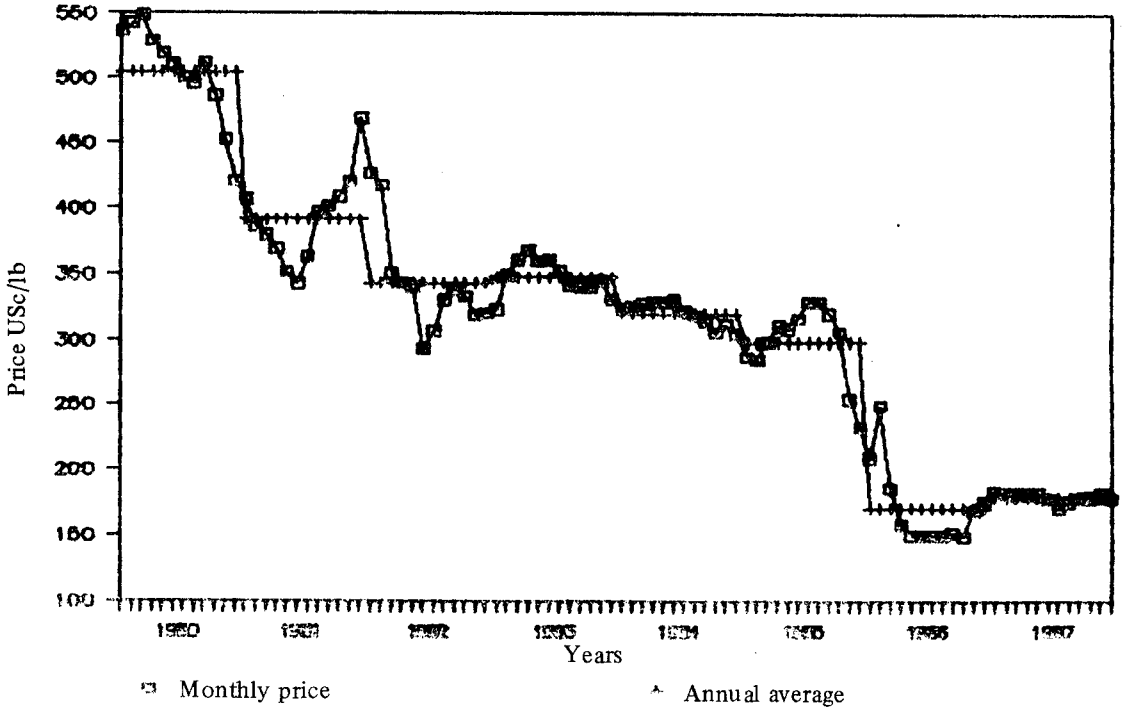
TIN PROD. USA

RATIO MONTHLY PRICE–ANNUAL AVERAGE



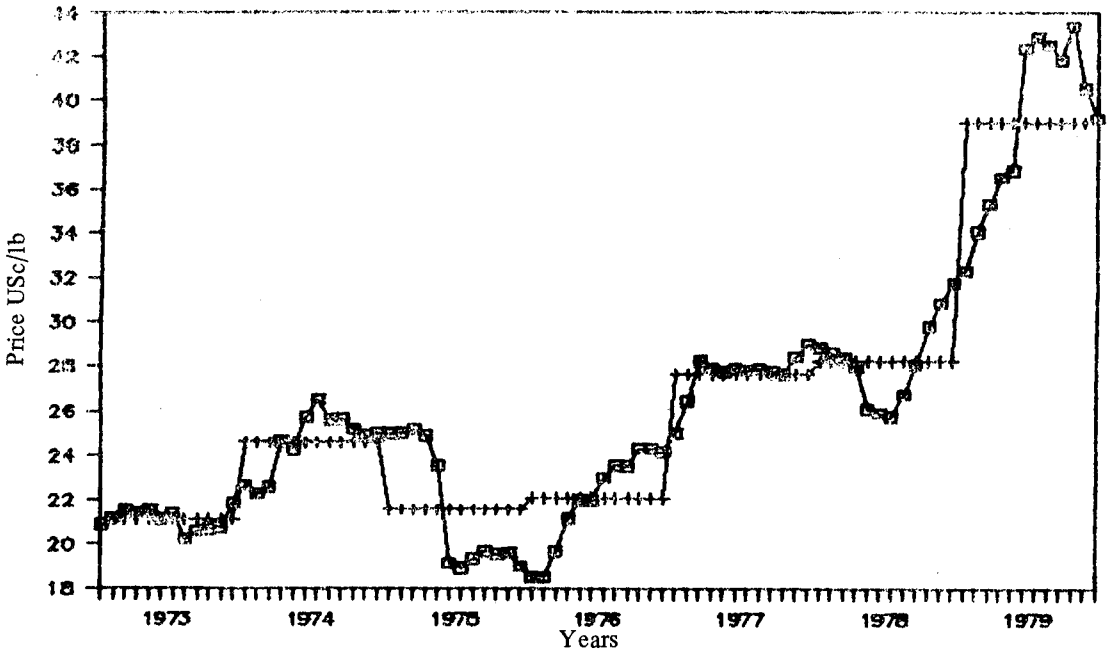
TIN PROD. USA

RATIO MONTHLY PRICE–ANNUAL AVERAGE



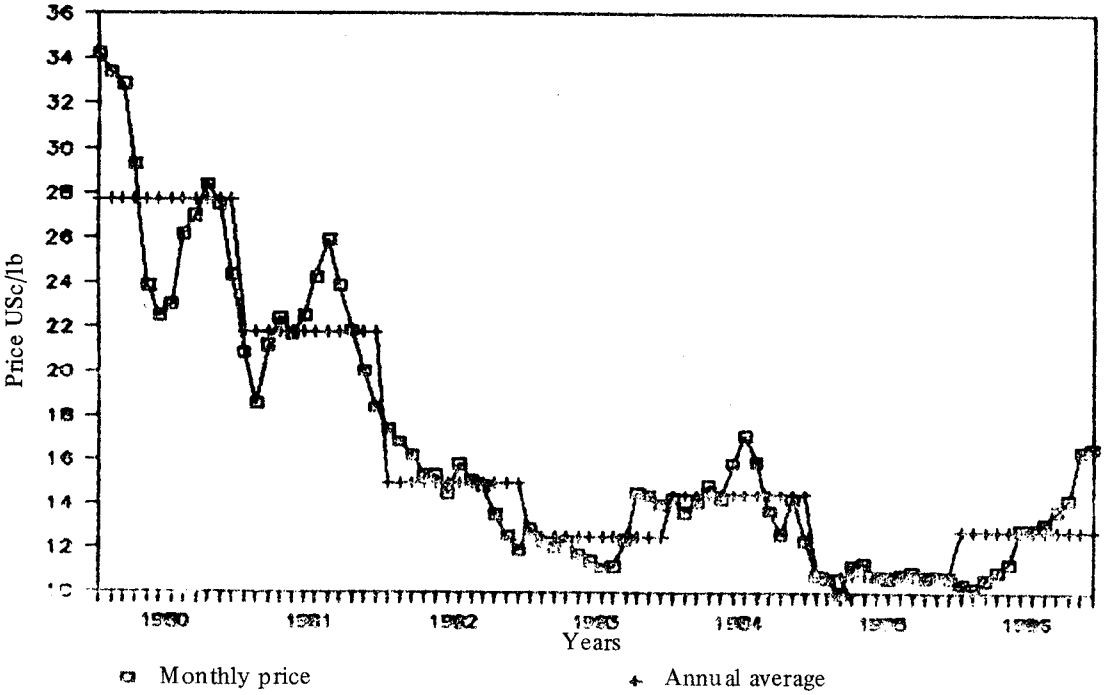
LEAD PROD. USA

RATIO MONTHLY PRICE–ANNUAL AVERAGE



LEAD PROD. USA

RATIO MONTHLY PRICE–ANNUAL AVERAGE

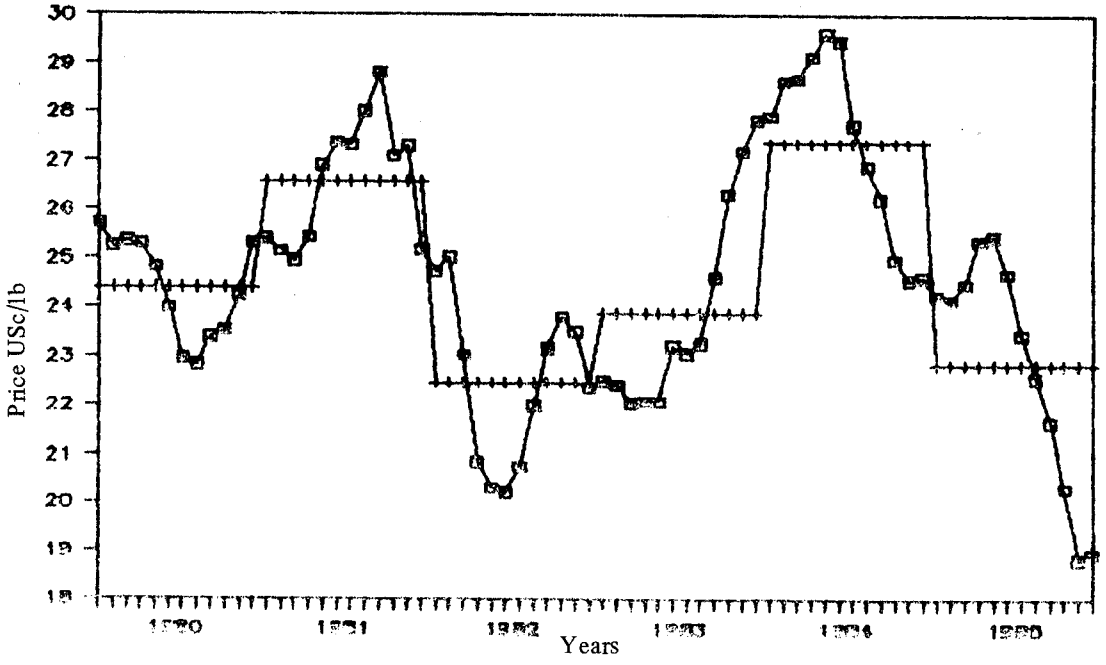


ZINC PROD. USA

RATIO MONTHLY PRICE–ANNUAL AVERAGE

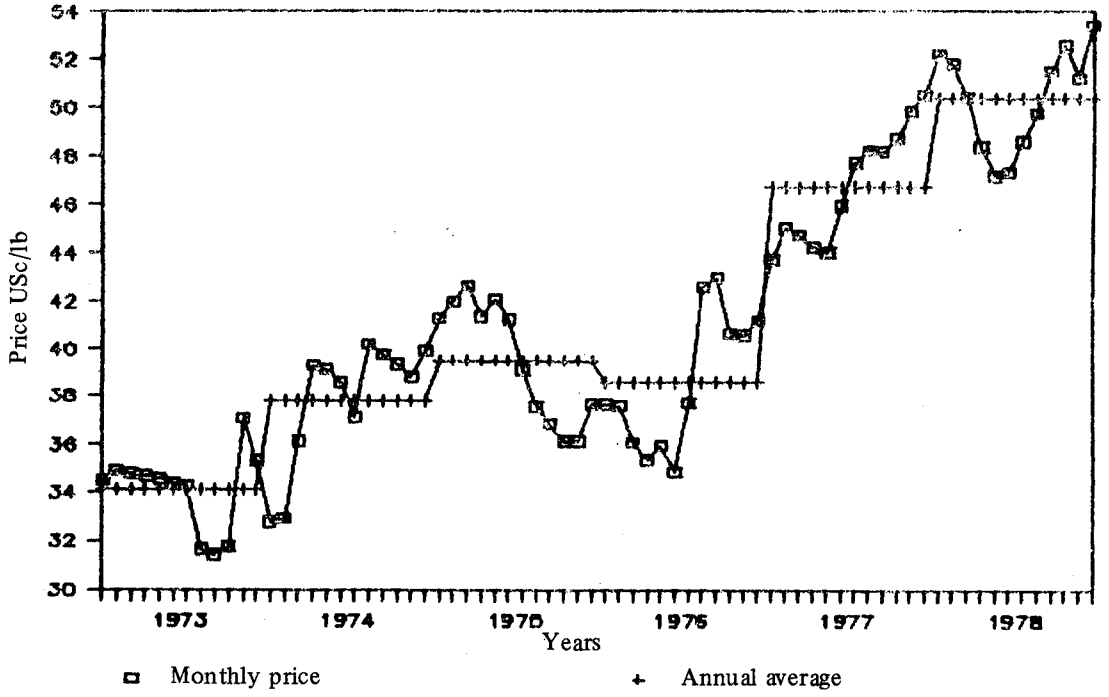
ZINC PROD. USA

RATIO MONTHLY PRICE–ANNUAL AVERAGE



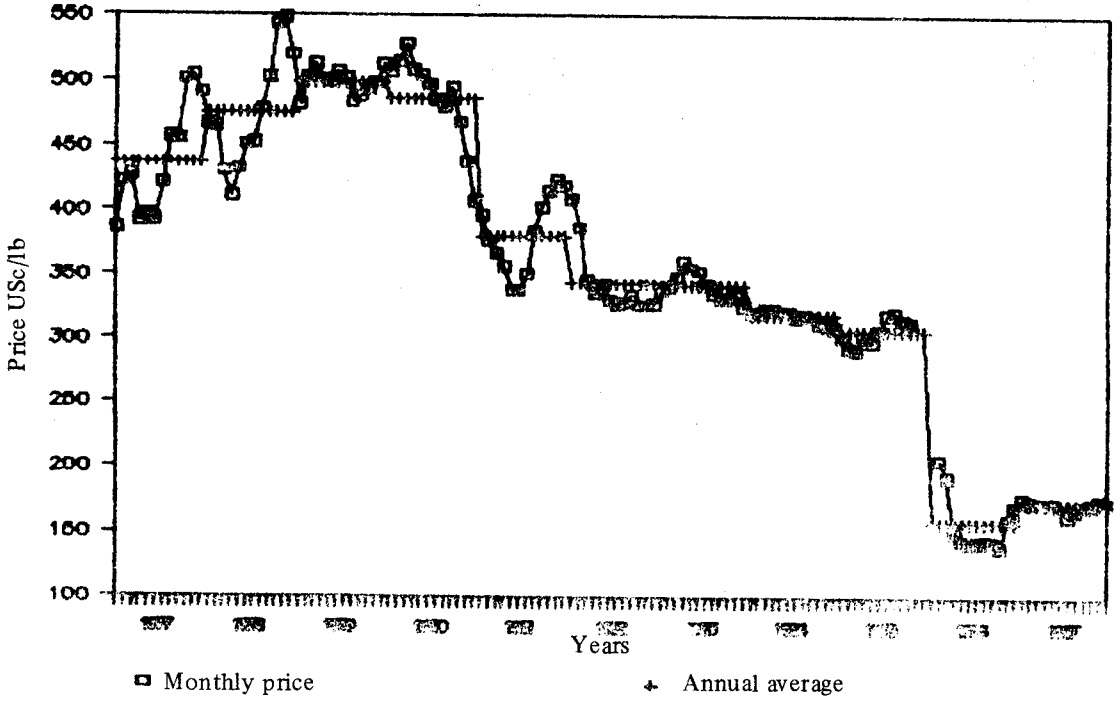
ALUMINUM–UNITED KINGDOM

RATIO MONTHLY PRICE–ANNUAL AVERAGE



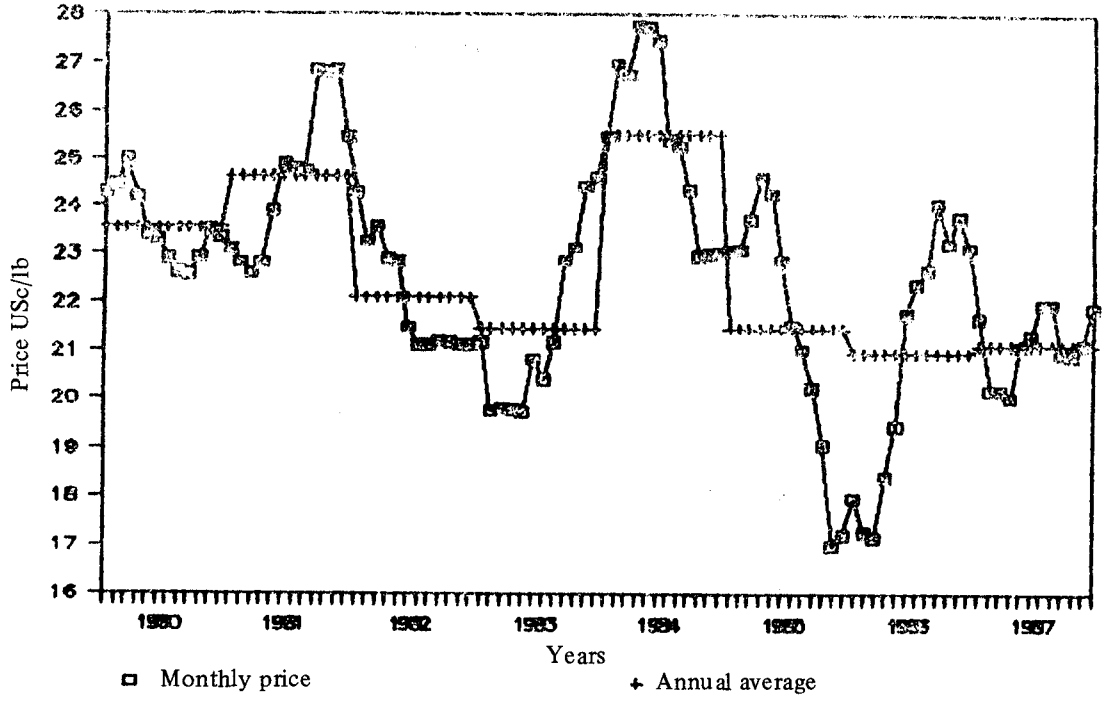
TIN PENANG MARKET

RATIO MONTHLY PRICE–ANNUAL AVERAGE



EUROPEAN ZINC PRODUCERS

RATIO MONTHLY PRICE–ANNUAL AVERAGE



ANALYSIS OF PRICES

RATIO STD/AVG BETWEEN METALS L.M.E.