

# CEPAL Review

*Executive Secretary*  
Norberto González

*Deputy Executive Secretary for  
Economic and Social Development*  
Gert Rosenthal

*Deputy Executive Secretary for  
Co-operation and Support Services*  
Robert T. Brown

*Technical Secretary*  
Adolfo Gurrieri



UNITED NATIONS  
ECONOMIC COMMISSION FOR LATIN AMERICA AND THE CARIBBEAN

SANTIAGO, CHILE, DECEMBER 1986

# CEP AL

Review

Santiago, Chile

Number 30

## CONTENTS

Reactivation and development: the great commitment of Latin America and the Caribbean. <i>Norberto González,</i>	'
Alleviation of the debt burden: historical experience and present need. <i>Carlos Massad.</i>	17
From austerity measures to structural adjustment. <i>Lucio Geller</i> and <i>Víctor Tokman.</i>	^
External debt and the reform of the international monetary system. <i>Arturo O'Connell.</i>	51
The origin and magnitude of the recessionary adjustment in Latin America. <i>Richard L Ground.</i>	"7
Turning page in relations between Latin America and the Caribbean countries. <i>Elvio Baldinelli.</i>	87
The international division of industrial labour and the core-periphery concept. <i>Kimmo Kiljunen.</i>	"
Services: a disquieting link between Latin America and the world economy. <i>Francisco Javier Prieto.</i>	117
Technology transfer in the mining sector: options for the Latin American Mining Organization (OLAMI). <i>Michael Nelson.</i>	137
The role of the public sector and transnational corporations in the mining development of Latin America. <i>Jan Kñakal.</i>	^3
Mining development in relation to the origin of capital. <i>Patricio Jones.</i>	^3
New objectives for the development of mining resources. <i>Rolando Sanz Guerrero.</i>	173
Recent ECLAC publications.	

# New objectives for the development of mining resources

*Rolando Sanz Guerrero*

The strategy for the development of the mining resources of Latin America is based on exploitation of the eight metal minerals for which there is greatest demand in the world market. The world crisis has been brought about not only by a decline in the export volumes and price levels of these products but also by a fall in the share of the developed countries in the mining exports of Latin America. The new markets which could absorb Latin America's mining production include its own market, taken as an integrated whole and not as a set of national markets. The dynamic potential of the regional market lies both in the expansion of per capita consumption (industrial use) and in the substitution of imports of mineral-based mining, metallurgical and manufactured products which together account for 40% of imports from outside the region.

To implement this new strategy action must be taken to attain the following objectives: a) the diversification of the production structure to bring it more into line with the region's needs and changes in the international market; b) the vertical integration of mining, metallurgical and industrial production to achieve an adequate level of regional self-sufficiency; c) the commissioning of new systems to facilitate intra-regional trade; and d) the implementation of programmes and projects of horizontal co-operation in order to disseminate the large stock of technological knowledge at present scattered among the various enterprises and institutions of the region.

•Staff member of ECLACS Division of Natural Resources and Energy. The author is grateful for the valuable assistance of Mrs. Georgina Ortiz in the preparation of this paper.

Latin America is a region rich in non-renewable natural resources. It has in its subsoil a great variety of metallic-mineral and energy resources. Despite this potential the region's productive structure is concentrated on eight metallic minerals destined mostly for the international market.

The region's mining sector has been dominated by a development pattern in which exploitation and processing has depended more on the stockpiling needs of the central countries than on domestic production needs. The mining sector thus helps the countries of the region to obtain inputs, machinery, equipment and other manufactured goods to meet its own needs; this is the reason for the difference between the purchase values of the minerals for the industrialized countries and the trade values for the developing countries. Whereas for the industrialized countries efficiency means obtaining these resources at the lowest possible cost or price, for the developing countries it is a function of the greater quantity of intermediate and manufactured goods obtained through trade, which depends on the volume and price of both exports and imports. Since for structural production reasons the demand-price of the imports of the developing countries is inelastic, the reaction to an increase in the price of imports is an increase in the volume of exports, which implies an age-long deterioration in the terms of trade. This difference between the price value and the trade value has caused a permanent conflict between the interests of the industrial countries and those of the developing countries, a conflict which various international forums have failed to resolve and which found its most dramatic expression in the escalation of hydrocarbon prices from the end of 1973-

## I

### The international mining products market

Latin America's situation underwent a dramatic upheaval in the period 1980-1985 with the drop in the rate of expansion of its exports and in raw materials prices; manufactured goods ran up against new protectionist policies on the part of

the developed countries and import prices rose—in a differentiated and unfavourable way for the region. At the same time, the hard terms of external credit, the high interest rates and short repayment periods meant that the servicing of the external debt increased at an annual rate of 30% (1975-1982); this situation is carrying Latin America into the worst financial and economic crisis in its history, for the growth rate of the total product has shown negative values for the first time in recent decades, and this means that large investments will have to be made up to the end of the 1980s to adjust the production and export structures to the new trends in the world economy and to restore the 1980 levels.

Mining has generally followed the development of foreign trade and most of the changes in its production and consumption structure are due to the events described above. However, this sector has its own characteristic performance, with greater growth in boom periods and deeper crisis in recessions.

The Western developed countries account for 40 to 45% of total world reserves, 50 to 55% of production, and 65 to 70% of consumption. The difference between consumption and production generates the majority of international trade. For all mining and metal products taken together, this group of countries generates 25 to 30% of world export volumes and receives in return 70 to 75% of total income as a result of the difference in the aggregate value of mineral raw materials and mineral-based manufactures.

Another of the main characteristics of the mining sector is the heavy concentration of world production of minerals in terms both of countries and of products. The production of 20 countries, including Brazil, Chile, Mexico and Peru, accounts for around 75% of world production. And 20 products represent some 95% of the value of world production, including the eight metallic minerals—iron, copper, lead, zinc, silver, bauxite, nickel and tin—which make up the larger part of Latin America's mining exports.

The volume and distribution of known mineral reserves, together with facility of access, are the main physical factors determining the possibilities of mining production. According to the figures of the Federal Institute for Geosciences and Natural Resources at Hannover concern-

ing 1981 reserves and 1980 production, there will be critical-world shortages of asbestos, lead and zinc. However, only 10% of the land with mining potential has been properly explored in Latin America, and the same could be true of Africa, Asia and the countries with centrally planned economies. The region's mineral reserves represented more than 30% of world reserves of niobium, columbium, lithium, iron, molybdenum and copper, and between 20 and 30% of bauxite, selenium, bismuth, nickel and silver. At the other extreme, they represented 1% or less of reserves of cobalt, gold, potassium, vanadium, chrome, magnesium, platinum and rutile.

In the period 1960-1980, owing to favourable economic conditions, the world saw a widespread increase in the annual production rates of the various minerals, ranging from 2.1% for lead to 8.7% for potassium. There was a similar trend in Latin America, although potassium, in contrast to what happened at the world level, showed a negative rate (-5.3%). For the rest of the minerals of the region the annual production growth rates were generally higher than the world rates.

In 1980-1983 a group of 15 minerals had negative world production rates, ranging from 1.4% (lead) to -16.4 (molybdenum). Seven of the region's minerals suffered larger production cuts than the world levels: bauxite (-11.1%), chrome (-23.0%), cobalt (-59.1%), fluorite (-9.2%), manganese (-6.3%), and nickel (7.8%). In contrast, there was a notable recovery in iron, gold, silver, lithium and bismuth. Latin American production of niobium, lithium, bismuth, silver, antimony, bauxite and copper accounted for more than 20% of world production. Fluorite, tellurium, iron, selenium, barite and tin had shares of between 15 and 20%. The levels of Latin American metal production were much lower than the region's share of mineral reserves and production, a fact which illustrates the region's relatively lower importance in the industrial processing of its metallic minerals. This production accounted for only 5 to 17% of world production of bismuth, tin, copper, manganese, lead, zinc, bauxite and nickel.

The movement in the world demand for mining products was not uniform either by region or by product in 1965-1983. A common feature was the downward trend in the subperiods 1974-1980 and

1980-1983- World consumption of the main metallic minerals increased at annual rates ranging from 1.7% for tin to 5.6% for nickel between 1965 and 1974. In 1974-1980 consumption ranged from -1.6% for tin to 2.1% for copper. In the last period (1980-1983) consumption was negative, except for copper, with annual rates fluctuating from -8.5% for bauxite to 1.9% for copper. In the period 1965-1980 Latin America consumed these minerals at annual growth rates higher than the world averages, ranging from 4.6% for tin to 20.9% for nickel in the subperiod 1965-1974, and from -2.8% for iron to 7.9% for copper in the period 1974-1980. In the period 1980-1983 Latin America's annual consumption rates were higher than the world averages for iron (19.9%), nickel (0.0%) and tin (-3.1%); however, the levels were lower than the average for bauxite (-10.9%), copper (-13.3%), lead (-8.1%) and zinc (-4.9%).

Latin America's low levels of industrialization and processing of minerals mean a low per capita consumption of metals and non-metallic minerals in comparison with the world averages: from 15 to 25% of world consumption of platinum, fluorite and bismuth, from 5 to 15% for manganese, antimony, asbestos, lead, copper, potassium, magnesium, zinc and mercury; and less than 5% for the others. While it is true that the variations in regional consumption still represent small volumes, they are more dynamic (with higher growth rates) than exports.

Changes in the production and consumption structures of minerals in the developed countries have repercussions on Latin America's share of world trade in these products. Between 1970 and 1980 its share of mineral exports declined from 15.2 to 13.54% and it increased to 17.01% in 1983. In contrast, metal exports showed a downward trend throughout the period with a share of 4.7% in 1970, 3.72% in 1980 and 3.5% in 1983. At current prices mineral exports grew at an annual rate of 7.9% between 1980 and 1983, following an annual decline of -1.1% between 1970 and 1980, a decline caused by annual drops of -7.0% and -6.9% in exports to the United States and Canada respectively. The biggest increases in the period 1980-1983 were achieved in exports to Canada, with annual rates of 32.6%; to other developing countries, 12.8%; and to the intra-regional market, 7.0%. Between 1970 and 1980 exports of metal products at current prices showed an annual decline of -2.1% owing largely to the fall

in exports to Canada (-30.7%), to countries of the European Economic Community (-6.6%), to other developed countries (-3.9%), and to Japan (-3.7%). In contrast, exports of metals to the countries with centrally planned economies increased at annual rates of around 21%, while the figure was 17% for the other developing countries.

Latin America's exports to countries outside the region were made up of the following minerals (the production percentages are shown in brackets): antimony (72%), bauxite (86%), bismuth (51%), cadmium (40%), cobalt (71%), copper (69%), tin (69%), iron (83%), lithium (98%), molybdenum (79%), nickel (76%), niobium (100%), gold (67%), silver (91%), lead (24%), rutile (100%), selenium (91%), tellurium (99%), tungsten (66%), and zinc (62%). In terms of value, eight of these minerals accounted for 95% of total mineral exports, which made up 10% of the region's total exports of goods. However, the ratio is higher for Bolivia (59%), Chile (53%), Guyana (44%), Jamaica (76%), Peru (34%), Dominican Republic (13%), and Suriname (82%).

In 1980 imports from outside the region were made up of 11 products, seven of which accounted for 99% of the value of mineral imports in that year. The group consisted of the following minerals (the percentages of the total supply are given in brackets): asbestos (57%), baryta (6%), chrome (16%), fluorite (1%), magnesium (5%), mercury (79%), platinum (99%), potassium (86%), phosphate rocks (52%), uranium (47%), and vanadium (22%).

In terms of relative prices the crisis had differing effects on the structures of mineral production, consumption and foreign trade. The minerals are classified in three groups: those which show an upward medium-term trend (1985-1990) —columbium, baryta, silver, lithium, magnesium, bauxite, tantalum, tellurium, zinc, vanadium, selenium, chrome and bismuth; those which maintain an almost constant level —arsenic, cobalt, gold, ilmenite, fluorite, rutile, nickel, manganese, mercury, copper, phosphate rocks, antimony and cadmium; and those which show a downward trend —thorium, potassium, platinum, molybdenum, sulphur, tin, irpn, lead, tungsten and asbestos. It must be remembered, however, that the trade value for the region

showed a constant deterioration from 1950 (table 1).

The industrialized countries maintained their position with the traditional argument that countries would obtain a greater volume of product if they specialized in the area of production in which they had the greatest comparative advantages. Accordingly, the developing countries which had the greatest relative supply of labour and natural resources should concentrate on the production of minerals and metals, while the industrialized countries with their greater relative supply of capital and technology and with larger consumer markets should specialize in the production of machine-based metals and manufactures. It was supposed that the long-term relative price of minerals would increase as a result of the gradual exhaustion of mineral deposits. In turn, manufactures were subject to periodic technological change which would increase the advantages of economies of scale and bring down real costs and prices. The figures given above show that the opposite happened, for the traditional theory took no account of variations in the earnings elasticity of demand with declining values in the case of commodities

and increasing values in the case of manufactures, nor of the strong trade-union pressures in the developed countries for wage increases in step with increases in productivity, nor of the operations of transnational corporations which in the end combine the process of production and marketing in mineral-based mining, metallurgical and industrial activities.

This shows that the structure of the international market was more favourable to the industrialized countries; the harm which this implied with respect to the attainment of the goals of the developing countries prompted them to defend their interests in various international forums. For example, the declaration made at the tenth special session of the United Nations General Assembly in 1974 set out a programme summarizing the aspirations of these countries: the New International Economic Order. Subsequently both the developed countries and the OPEC countries refused to engage in a dialogue on the subject and insisted that international trade should be governed by the economic laws of a competitive market and that multilateral decisions should continue to be taken in the

Table 1

**LATIN AMERICA: TRADE VALUE OF MINING EXPORTS, 1950 TO 1985**

Year	Real price index of mining exports	Real price index of imports of manufactures	Index of the terms of trade
1950	100	100	100
1955	102	117	88
1960	89	128	70
1965	104	132	79
1970	125	147	85
1974	119	262	45
1978	73	386	19
1980	90	465	19
1981	80	442	18
1982	74	433	17
1983	76	415	18
1984	69	403	17
1985	62	424	15

Source: ECLAC (1986).

framework of GATT, the World Bank and the International Monetary Fund.

In 1976 UNCTAD approved the Integrated Programme for Commodities, which includes the negotiation of a series of agreements for a selected group of resources. The fundamental element in this Programme is the Common Fund, an instrument designed to cope with the financial needs arising from operation of the agreements. Producer and consumer countries were to participate in these agreements with a view to regulating the market in each resource. However, the lack of concrete results is causing new frustrations of the aspirations of the developing countries. The 1981 Cancun Conference produced a similar result; however, a proposal was submitted to this Conference by France, supported by Canada and Sweden, that the developed countries should discuss with the representatives of the Group of 77 a far-reaching allocation of resources and a technical co-operation plan; this proposal met with unyielding opposition from the United States and the United Kingdom which was shared for various reasons by Japan, the Federal Republic of Germany and the OPEC countries.

This situation of conflict has caused the leading industrialized countries to adopt a series of measures to minimize the use of mining resources which they do not have in their territories and reduce their vulnerability to possible interruptions of external supplies. In turn, the exporter countries, in order to cope with pressing balance-of-payments problems, have adopted different measures to maximize their earning from mining exports, including the establishment of voluntary production and export quotas in order to maintain or increase prices.

The United States Government is concerned about the high level of dependence of United States industry on imports of certain mining products such as antimony (51% of its requirements), asbestos (80%), bauxite (94%), cobalt (91%), chrome (90%), tin (80%), manganese (98%), nickel (72%), silver (50%), potassium (68%), tungsten (52%), and zinc (67%); it has therefore proposed a series of measures of various kinds, including the following:

a) Increasing mining investment abroad with its own or joint programmes and projects, provided that they do not harm the country's

domestic mining interests. The main incentives are the reduction or elimination of double taxation, tariff reductions and systems of international arbitration to resolve conflicts about nationalization or expropriation.

b) Developing trade relations with South Africa, Australia, Canada and Mexico, major suppliers of mining products to the United States.

c) Strengthening its naval power to protect the main shipping routes, especially those used for the transport of hydrocarbons.

d) Embodying in concrete actions the concept of the three-ocean alliance (a grouping of the NATO countries with South Africa, Saudi Arabia, Australia, Brazil, Egypt, Indonesia, Mexico, Nigeria, Singapore and Zaire). This alliance would deliver not only greater military and economic strength but also a greater concentration of scientific knowledge and supplies and reserves of petroleum and the principal minerals.

The European Economic Community also depends to a high degree on mineral imports. It obtains 20% of its needs from its own resources, 40% from other developed countries and 40% from developing countries. Its import needs for the main products, as percentages of the total supply, are as follows: aluminium oxide 84%, antimony 91%, asbestos 82%, cobalt 100%, copper 67%, chrome 100%, tin 95%, iron 79%, manganese 99%, mercury 86%, molybdenum 100%, nickel 80%, gold 99%, silver 98%, lead 45%, phosphate rocks 99%, tungsten 77%, vanadium 100%, and zinc 52%. The Community does not seem to have any great possibility of increasing its self-sufficiency for it is the oldest consumption centre and has almost exhausted its resources. A high degree of dependence could be tolerable provided that the sources of supply are diversified; however, direct European investment has been stable for many years, but it has not reached the levels of the United States and Japan. In addition, this investment has been directed primarily towards other, politically more stable developed countries which themselves have high consumption rates. For these reasons the Commission of the Community has proposed a number of joint undertakings.

In 1975 the Commission submitted to the Council an analysis of the risks involved in Europe's high level of dependence on supplies of mineral raw materials from third-world countries, and it proposed the basic goals for the development of a Community policy in this area. These goals focus on long-term security of supply, the need to provide guarantees for mining investment abroad, price stabilization, the possibility of increasing the region's mining resources, and the achievement of economies of scale in the industrial processing of these raw materials.

In 1978 the Community organs decided to give priority to the mining sector and proposed a further series of joint measures also designed to encourage the exploration and production of Europe's own resources and facilitate access to mining resources from abroad. These measures include the implementation of a programme of several years' duration (1978-1981) for research and development of Europe's own resources.

The scope of this programme was subsequently extended to the period 1982-1985. Moreover, in January 1978 the Commission submitted to the Council a communication defining the modalities of the Community's investment operations in developing countries which basically covered the activities of European mining companies abroad: exploration and investment within the framework of a system for promotion and protection of such investment.

Up to the present, stages I, II and III of the Lomé Convention have been signed with 66 countries of Africa, the Caribbean and the Pacific (ACP countries) associated in the Convention. The STABEX system has been operated since the first Convention with the object of offsetting the effects of a sharp drop in the export earnings of the ACP countries by means of financial transfers from the European Development Fund (EDF) which are suspended when the original situations are restored. Iron ore is included in this system. SYSMIN is the arrangement for other minerals which was established in the Lomé II Convention. It offers the ACP countries the essential minimum protection needed to maintain and develop their export capacity in the event of natural disasters, serious political upheavals or price reductions. This system covers exports of copper and cobalt from Zam-

bia, Zaire and Papua New Guinea, phosphates from Togo and Senegal, manganese from Gabon, bauxite and aluminium from Guinea, Jamaica, Suriname and Guyana, tin from Rwanda and pyrites and iron from Mauritania and Liberia. With a view to developing the mining potential of the ACP countries, the European Investment Bank (EIB) furnishes the necessary technical and financial assistance by means of long-term loan agreements.

Japan is also largely dependent on external mineral supplies: antimony 100%, asbestos 99%, bauxite 100%, cobalt 100%, copper 87%, chrome 99%, tin 96%, iron 99%, manganese 97%, molybdenum 99%, nickel 100%, gold 94%, silver 73%, lead 75%, phosphate rocks 100%, tungsten 75%, vanadium 100%, and zinc 59%. In order to obtain regular supplies at the lowest possible cost, Japan has pursued a policy of diversification of its external sources, which are located mainly in the countries of the Pacific and Asia, in Australia and South America and occasionally in African countries. This policy has two main tools: long-term sales contracts associated with loans for mining equipment and joint ventures in projects or mining enterprises.

The USSR is the world's second producer of minerals after the United States; it has big reserves of non-energy minerals and plays an important role in trade, with its exports of minerals, metals and fuels accounting for 50% of the total value of its exports in 1979. However, in recent years there has been a considerable decline matched by an increase in the imports of the group of countries with centrally planned economies, especially of chrome, tin and lead. It is calculated that import needs for the main minerals account for the following percentages of the USSR's total demand: antimony 20%, baryta 50%, bauxite 50%, cobalt 43%, tin 11% and fluorite 47%.

To date the wish of the mineral-producing countries to control the market for their exports has met with very little success. The intention is to maintain or increase prices in the event of an excess of supply occurring in periods of low expansion of economic activity in the industrialized countries, to prevent any further deterioration in the terms of trade with the developed countries and to maximize foreign-exchange earnings to solve balance-of-payments prob-



lems. The most serious initiatives for combining the interests of the producer countries were the establishment of cartels (CIPEC, IBA) along the lines of OPEC: however, they have not operated with the expected effectiveness for various reasons such as deviation from the original objectives and lack of political affinity between their concepts and procedures.

Apart from the possibilities of forming oligopolies of producer countries, it must be remembered that the minerals market already has oligopolistic associations of transnational corporations showing a greater tendency for horizontal integration of an increasing number of minerals, including ones which can be substituted, in addition to associations which already involve the vertical integration of successive stages in the production and industrial processing of the various minerals. These corporations naturally serve their own interests, which in some cases and circumstances coincide with those of the producer countries; this might offer

opportunities for joint action, to protect prices for example, with subsequent determination of the distribution of the marginal income. In addition to this type of corporation, there are other international companies which market mineral raw materials and exercise differing degrees of influence and control in these markets. The world crisis has consolidated the importance of these companies and enhanced their profit-earning capacity. They have thus become dynamic agents in the marketing of minerals, and it would also be possible for the producer countries to enter into association with them, or set up their own organizations of this kind.

The trade policy of both importer and exporter countries could bring about a degree of stability in the minerals market, but this would not be sufficient to overcome the problems of the mining conflict which will continue to accentuate the economic prostration of the developing countries with its consequences of political and social instability.

## II

### The crisis and prospects of the international market

An economic crisis can generally be defined as a period of difficulties and costly changes in the structures of consumption, production and foreign trade which in turn express themselves as new values of the trends and parameters of the previous period. The model prevailing since the end of the Second World War based its dynamics on the rapid expansion of foreign trade with extensive exchange of manufactures among the industrialized economies of the North and the trading of manufactures for raw materials between the countries of the centre and those of the periphery. The main features of production were the dominance of mechanical methods and direct human control over production processes and the great gap of technology and capital accumulation between developed and developing countries. The mass consumption of

goods was also characterized by an earnings elasticity which was increasing for manufactures and decreasing for commodities.

Now that the crisis has been overcome, the world economy is faced with a very different situation in which protectionist practices are being imposed to help laggard industries and in which the front-line industries are dominated by the new technologies of robotization and programmed and automated controls and commands. These technologies reduce the direct demand for labour and the use coefficients of the main mining and energy resources per industrial unit produced. This new industrial structure is a response to the changes taking place in the levels and patterns of consumption, characterized in the developed countries by a high level of saturation with respect to durable manufactured goods

and by great earnings elasticity for services, especially those based on information technology and electronics.

Since the crisis therefore the world economy is offering even less favourable conditions for the developing countries. On the one hand, they will have to take up the challenge of obtaining sufficient resources to service their external debt and change their production and export structures. On the other hand, it will be difficult for them to obtain these resources solely by expanding their exports, for the widening of the gap of technology and capital accumulation will impede their exports of manufactures and erode their comparative advantages based on the greater relative availability of labour and mining and energy resources.

Accordingly, the adaptation of the developing countries to the new conditions of the world economy will depend initially on the decisions of the industrialized countries on the following basic points:

- a) The nationalization of the external debt by the governments of the developed countries so that it can be renegotiated on concessionary terms with low interest rates and long repayment periods.
- b) The transfer of technology in the industrial branches in which the developing countries are to specialize.
- c) Complete openness to the exports of the developing countries on the basis of competition.
- d) Favourable trade balances with the developing countries achieved by the granting of new lines of credit designed to speed up the formation of capital.

It must be admitted that at present there are no grounds for believing that the developed countries will wish to take these decisions. The developing countries will have to have a rethink about more independent systems based initially on the integration of each of the regional markets and subsequent development of interregional complementarity, which will have the hypothetical objective of formation of a macro-market of the South. As a second stage the developing countries will have to achieve a greater share in the macro-market of the North based on the combined trade dynamism achieved in the first stage, on accelerated technological

development and on an adequate concentration of capital goods. The productive structure will thus need a great adjustment capacity to enable it continually to modify its comparative advantages and exploit the benefits to be derived therefrom by means of constant analysis of the major differences in the situations and prospects of each of the industrialized countries. In current values the total exports of Latin America increased at an annual rate of around 20% in 1970-1980 and at less than 1% in 1980-1984. In this latter period the main increases were in exports to other developing countries and to the United States (8% and 6% a year respectively). In contrast, there was a decline in exports to other countries in the region (-3.3%) and to the EEC countries (2.1%). The annual rate for imports exceeded 21% in the first period and declined by more than 6% per year in the second period. The largest declines were in imports from other developing countries (hydrocarbons) and from Europe (EEC and EFTA) with annual rates of around 10%.

Latin America's foreign trade in minerals and metals developed along the same lines as total trade (tables 2 and 3). In the first period exports had an annual growth rate of around 14% but declined in the second period (-4.4% a year). Imports grew by almost 18% in the first period and declined (-8.4%) in the second.

Table 2

**LATIN AMERICA: DESTINATION  
OF EXPORTS OF MINERALS  
AND METALS**

(Percentages)

	1970	1980	1983
Latin America	6	12	8
European Economic Community	37	33	28
Centrally planned economies	5	6	7
United States	30	18	21
Japan	11	7	9
Other developed countries	5	9	9
Other developing countries	1	6	10
Unclassified	2	9	8

Source: United Nations (1984).

Minerals and metals had a smaller share in Latin America's total exports (18% in 1970, 11% in 1980 and 9% in 1983). The drop in the share of imports was smaller —11.8% and 7% in the years indicated.

One of the relevant points is the decline of all the developed countries as a market for consumption of Latin America's exports of minerals and metals as a result both of the downturn in the growth of exports to the developed countries, with the annual rates falling from 12% in 1970-1980 to -4.5% in 1980-1983, and of the more favourable volumes of exports to the developing countries, with values of around 32% for the first period and 9.5% for the second.

Table 3

**LATIN AMERICA: ORIGIN OF  
IMPORTS OF MINERALS  
AND METALS**

(Percentages)

	1970	1980	1983
Africa	1	1	2
Latín America	11	15	11
Asia	1	1	1
Centrally planned economies	5	4	7
Developed market economies	81	76	76

Source: United Nations (1984).

While Latin America's exports to the United States increased in 1983-1984, its exports to other developed countries remained stationary or declined. However, faced with a growing trade deficit the United States stepped up its protectionist policy, with harmful consequences for mining products from Latin America, so that total exports of these products fell by around 2% in 1985, a trend which has continued during the first months of 1986.

Another cause of this downward trend can be found in the relative performance of the United States GDP as a proportion of the world product, declining from 38% in 1970 to below 28% in 1982. Forecasts made by various bodies indicate that the United States GDP will grow by 2 to 3.5% in the second half of this decade. It is

not easy to predict the economic performance of the United States owing to a variety of structural contradictions which have subjected it in recent years to a series of recessions. Nor should it be forgotten that the United States is developing from an economy of mass production of goods to one producing services, which account for almost 70% of GDP. It must be assumed therefore that the economy's growth now depends on human capital rather than on the accumulation of capital assets. However, between 1970 and 1983 gross investment in fixed assets increased by 60% while employment grew by only 36%.

It must also be remembered that services depend on the availability of the capital goods which generate them. It is clear that the development of both sectors must be closely linked, for if the United States loses its production base for capital goods, it will also lose its technological leadership in services.

This technological change will have both positive and negative effects on the consumption levels of the various minerals and metals. On the one hand, its rapid expansion promotes a certain group of the lightest mining products of the quality required by the new industries. On the other hand, there is less use of the traditional mining inputs per unit of industrial production, and new materials are being produced to take their place (such as optical fibre as a substitute for copper).

These processes give rise to new problems, such as whether it will be possible to maintain the coefficients between GDP growth and the industrial product and between this product and the use of the main mining products exported by Latin America. According to historical parameters, if the United States GDP increased by 2 to 3.5% a year, it is to be expected that its industrial product would increase by 4.5 to 6.7%. However, with the new parameters of the period 1970-1985, which indicate a greater relative growth of services than of industry, it would be more realistic to place the industrial sector's expansion rate in the range of 2.6 to 4.5%.

In addition to expanding at a slower relative rate, the structure of the industrial sector is undergoing important changes and greater dynamism is being acquired by the high-technology subsectors (aerospace, computers, electronic components, instruments, electrical

machinery and chemical products), while the share of the medium- and low-technology sub-sectors, such as metals and metal products, is declining. This situation is causing changes in the demand structure of minerals and metals, with a rapid expansion of light metals and a contraction of heavy metals, including Latin America's main export products.

In addition, new materials are being manufactured which form a new generation of substitutes for the traditional mining and metal products such as: the reinforced and high-resistance plastics obtained from polyester and fibres of glass, coal, boron, aluminium, silicon and silicon carbide; the metals and reinforced ceramics used in the strategic industries which require materials resistant to high temperatures;

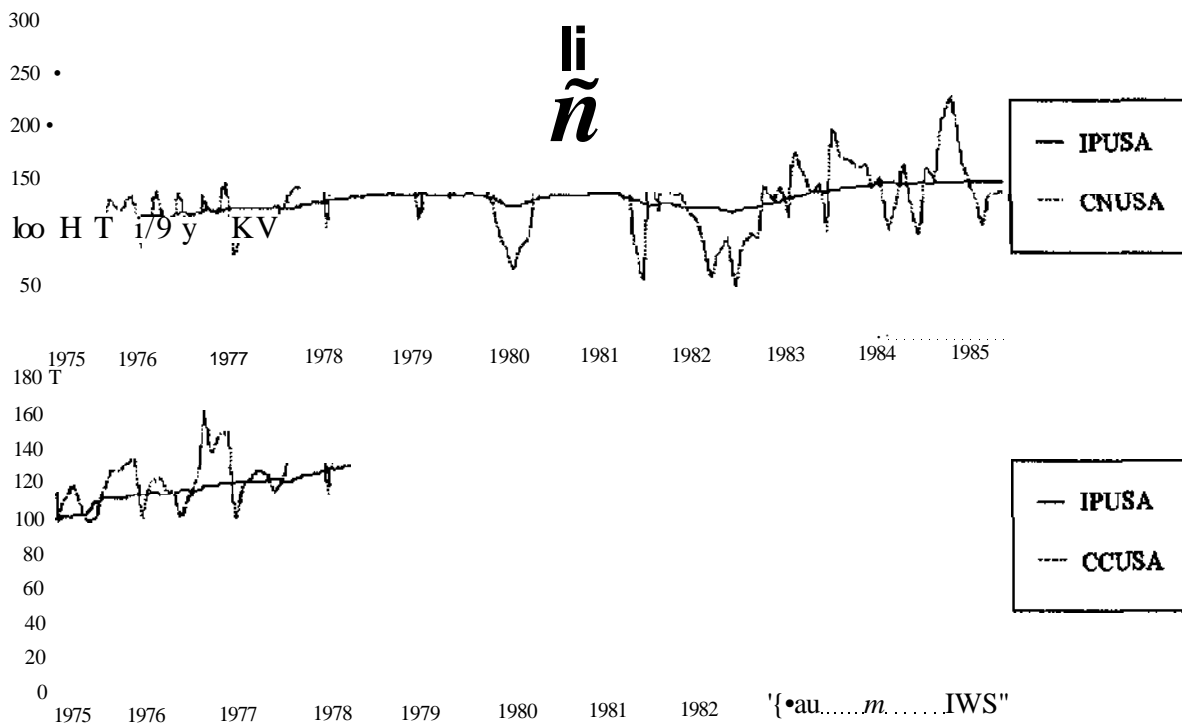
the products of titanium and its alloys with their resistance to corrosion and high temperatures, low expansion and low specific gravity; and the optical fibres which compete with conductor metals such as copper. Lastly, it must be remembered that this industrialization process is emerging in the shelter of various forms and practices of protectionism and controlled trade designed to protect basic industries and the subsectors of greatest technological backwardness.

These factors are affecting to different degrees the consumption patterns of the main metallic minerals exported by Latin America:

*Copper:* Figure I shows that the consumption index of copper (industrial use) in the United States was always higher than the industrial product index up to June 1980; from that date is

Figure I  
INDEXES OF INDUSTRIAL PRODUCT OF THE UNITED STATES (IPUSA)  
AND U.S. CONSUMPTION OF NICKEL (CNUSA) AND COPPER (CCUSA)

(Base: August 1975 • 100)



Source: United States Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, various issues. United States Department of the Interior, Bureau of Mines, *Minerals and Materials*, various issues.

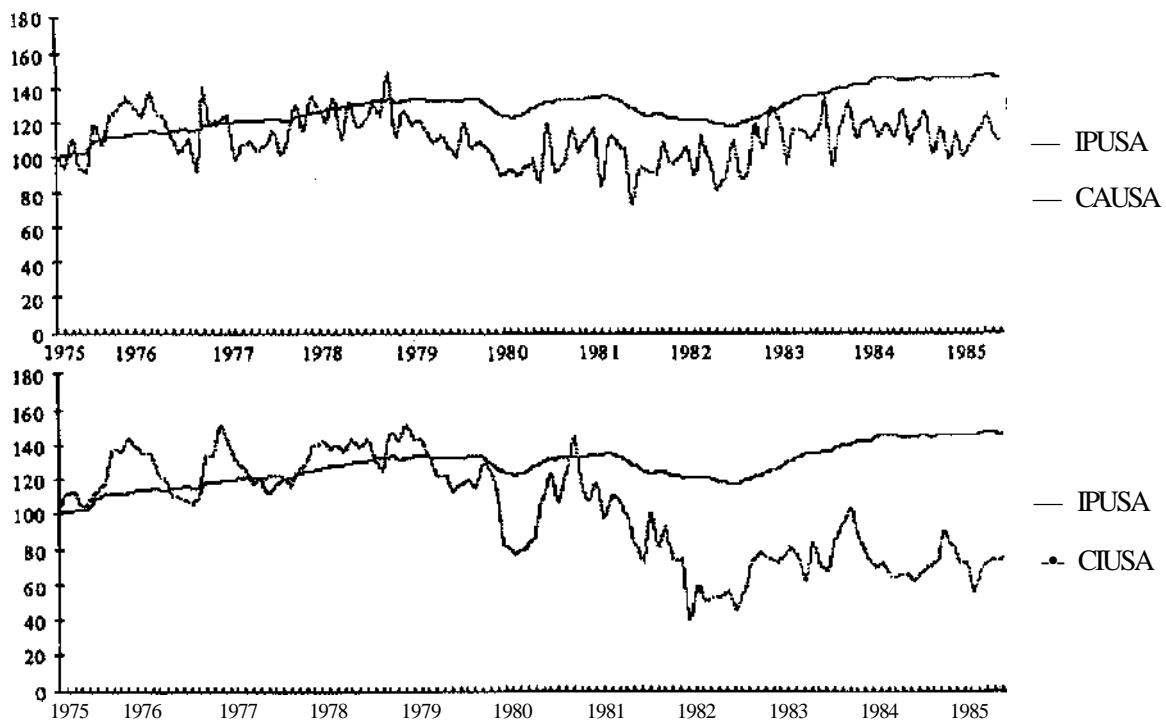
has been lower. Given the new parameters and the expected growth of the industrial sector by annual rates of 2.6 to 4.5 %, the consumption of copper should increase at annual rates of 2.1 to 2.9%, which means that it will take some 20 years to return to the maximum consumption levels achieved in March 1979.

*Nickel:* Up to October 1983 consumption maintained a close relationship with the industrial product, with technical coefficients higher than unity. Since November 1983 the coefficient has been negative and a future consumption decline of 6% a year can be expected, if the correlation does not decline so far as to invalidate the forecast. There was a decline in the correlation coefficient of other metals during the crisis (1980-1982) and it is assumed that this was

caused by the reconversion of the metal industries. Since then (1983-1985) these coefficients have climbed back, establishing new values for the parameters of the historical trend. In the case of nickel, reconversion seems to be lagging behind the other metal industries, so that the new trend will not be discernible for a few years.

*Aluminium:* The maximum consumption of aluminium was also achieved in March 1979. Since then the consumption index has been lower than the industrial index, establishing a new trend (figure II). With application of the new parameters, consumption may be expected to grow in coming years at annual rates in the order of 10%, which means that the March 1979 maximum will be achieved at the end of this decade.

Figure II  
INDEXES OF INDUSTRIAL PRODUCT OF THE UNITED STATES (IPUSA) AND  
U.S. CONSUMPTION OF ALUMINIUM (CAUSA) AND IRON ORE (CIUSA)  
(Base: August 1975'-100)



Source: United States Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, various issues. United States Department of the Interior, Bureau of Mines, *Minerals and Materials*, various issues.

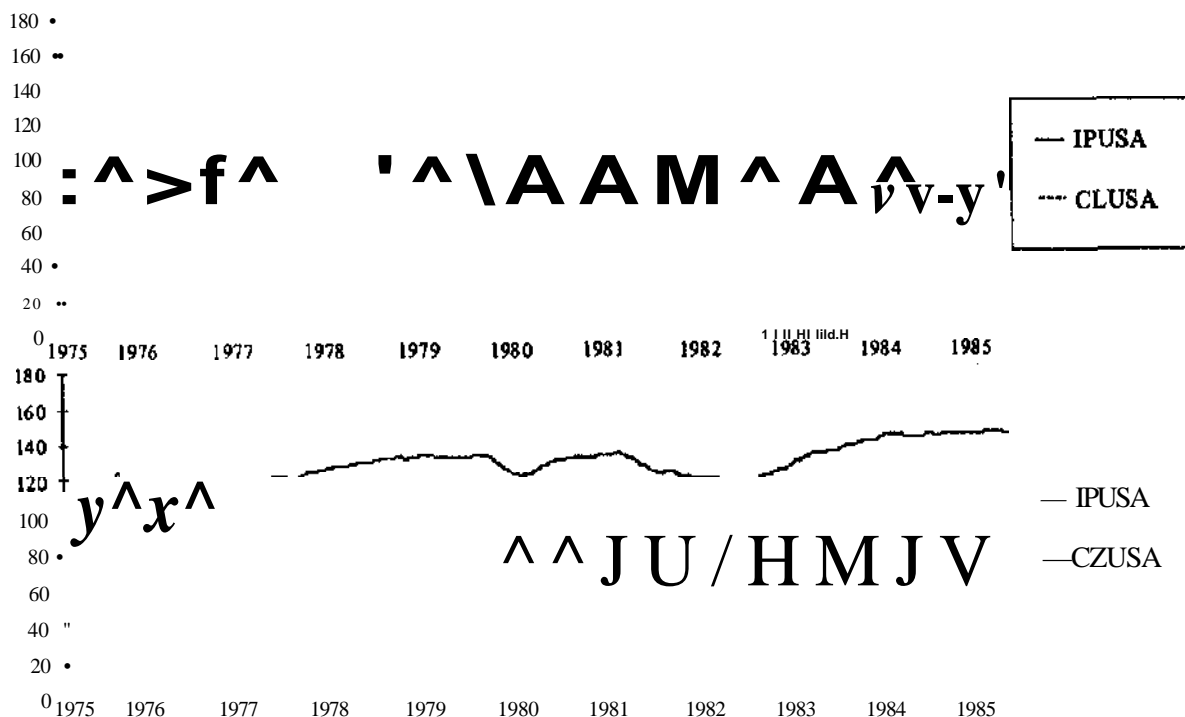
*Iron:* In terms of volume, iron is the mineral of greatest consumption in the United States. Maximum consumption amounted to some seven million tons in May 1979. The shift to the new consumption trend occurred in that same year and in December 1985 the volume was slightly above two million tons (figure II). Assuming a strong recovery in consumption levels at annual rates of 7%, the 1979 maximum will be achieved at the end of the century and only then will it be possible to make full use of the present production capacity.

*Lead:* The decline in lead consumption from 1976 reached its lowest point in November 1983 (figure III). According to the parameters of the new trend, lead consumption may continue to decline at annual rates of around 5%.

*Zinc:* Of the cases analysed, the zinc metal industry was the one which began its conversion most quickly. Maximum consumption occurred in March 1976 and the new trend set in at the end of that year. According to the new parameters, consumption in coming years may grow at annual rates of around 5%, requiring a decade to reach the 1976 maximum.

Changes in the consumption of minerals and metals has not been the only factor affecting the production decisions of the United States and the other developed countries. There have been other influences, such as for example the desire, following the oil crisis, to reduce dependence on imports of petroleum products through increases, not always profitable ones, in domestic production. Another consideration has been the

Figure III  
 INDEXES OF INDUSTRIAL PRODUCT OF THE UNITED STATES (IPUSA)  
 AND U.S. CONSUMPTION OF LEAD (CLUSA) AND ZINC (CZUSA)  
 (Base: August 1975 =100)



Source: United States Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, various issues. United States Department of the Interior, Bureau of Mines, *Minerals and Materials*, various issues.

relative shortage of each mineral. Since these are non-renewable resources, in principle this factor imposes a limit which at some point could become a restrictive or critical factor in mineral supplies. This topic of the limits of mineral resources has been dealt with in several reports which in one way or another seek to describe the world of the end of this century in terms of a series of parameters.

Taking the pessimistic assumption about natural resources, Leontief (1977) asserts that the group of developed countries will have critical production shortages in about 2000 for nickel, zinc and lead and that the group of countries with centrally planned economies will have shortages for these three minerals plus copper.

OECD (1979) calculated the mining resources which might be considered as reserves given large increases in their prices in the medium and long terms, noting that there was a general ratio of three to one between resources and reserves. However, by 2000 there would be critical world production problems for bismuth, mercury, lead, zinc, asbestos and silver.

The Carter Report (1980) concluded that the relatively short life-expectancy of certain materials does not mean that they will be exhausted in the immediate future, but that the reserves of at least half a dozen minerals—industrial diamonds, silver, mercury, zinc, sulphur and tungsten—will have to increase if production levels are to be maintained over the coming decades. In the light of these estimates, there would be areas or regions with a high level of supply and access for a number of mining resources which would be in a better position to exploit them on an integral basis and trade them to other regions which possess other resources, capital goods or technology. This theoretical division of world mining production would reduce the medium-term financial requirements for prospecting and exploration of mineral resources, except for those for which there are world shortages, such as lead and zinc. However, the developed countries have taken a number of initiatives designed to increase their self-sufficiency, including the following:

a) During the 1950s and 1960s the developing countries managed to obtain up to 60% of the resources used for mineral prospecting and exploration; in the following decade the situa-

tion was reversed, with 80% of these resources concentrated in the developed countries themselves, including Australia, Canada and South Africa. The United States was thus able to become one of the leaders in terms of reserves of important minerals such as asbestos, baryta, bismuth, cadmium, copper, fluorite, lithium, mercury, molybdenum, gold, silver, lead, rutile, selenium, tellurium, tungsten, zinc and zircon.

b) In the United States and other developed countries the secondary recovery of metals from scrap forms part of production. Scrap metal is accumulated quickly in these countries, which also account for 90% of international trade in this product. It is calculated that the secondary production of metals at present represents from 25% (zinc) to 50% (lead) of the total production of the developed countries and that by 2000 reserves of scrap metal could meet approximately 60% of world demand for the principal metals.

c) One of the factors determining the position and level of mineral supply and demand in the short term is the formation and use of stocks of these products for strategic, trade or regulatory purposes. The United States, France, Japan and the Federal Republic of Germany, which are heavily dependent on imports of several minerals, have established strategic reserves against the possibility of shortages, even though they have been used on various occasions for purposes of stabilization or even for commercial purposes when liquidity was needed or consumption estimates were exceeded.

d) Another factor which might affect the long-term supply of certain minerals is the exploitation of seabed nodules, which usually consist of a combination of manganese oxide (8 to 40%), cobalt (0.1 to 2%), nickel (0.2 to 2%) and copper (0.3 to 1.1%). It is estimated that these reserves would be greater than the reserves on land in the case of manganese, cobalt and nickel and that possible production in 2000 could meet 100% of the world demand for cobalt, 33% for manganese, 80% for nickel and 7% for copper.

The double effect of a slowly recovering consumption and the possibilities of increasing the supply itself does not offer a very rosy prospect for Latin America to expand strongly its exports of minerals and metals to the United States, not

even with a rapid recovery of the United States global economy, which in relative terms still absorbs more than 20% of Latin American exports of these products.

The countries of the European Economic Community are the main market for Latin America's mineral and metal exports; however, this share has also shown a constant decline (from 37% in 1970 to 28% in 1983). Although the Community's GDP growth rate during the period 1974-1982 was 70% lower than in 1950-1974, it has maintained a slightly increasing share of the world product. This development cannot therefore be one of the main factors determining the decline in mineral and metal imports from Latin America. In contrast, the ratio of GDP to metals consumption has fallen considerably (table 4).

Table 4

**OECD: EVOLUTION OF THE GDP  
MULTIPLIER WITH RESPECT TO  
CONSUMPTION OF METALS**

*(Annual growth rates)*

	1950-1974	1974-1982
GDP	6.2	1.7
Aluminium consumption	9.3	-0.4
Multiplier	1.5	-0.2
Copper consumption	3.8	0.6
Multiplier	0.6	0.3
Nickel consumption	6.3	-2.9
Multiplier	1.0	-1.2

*Source: Association of Geoscientists for International Development (1986).*

According to the new parameters, the revival of the European economy will not entail a spontaneous recovery in the consumption of the principal metals, for the levels are out of phase not only because of the high degree of saturation but also as a result of changes in the production structure. At the end of the 1960s it was already apparent that growth rates were weakening in certain mineral and metal consuming sectors and were losing their relative importance in such

sectors as construction, iron and steel, metallurgy, electrical engineering and chemicals. This trend grew more intense from 1973 and spread to other sectors such as heavy machinery, engines, specialized machinery, machine tools and heavy electrical equipment.

Although it is still too early to assert that this group of countries is emerging from the crisis, there are signs that the day is not far off. These signs include the mastery of inflation, major works of scientific and technological research, and the new dynamics and direction of investment. Investment in fact —with an annual expansion rate of around 1.5% in 1970-1983— climbed to 5% in 1984-1985. This investment was intended primarily for the protection of domestic industry and for the immediate utilization of export opportunities. It was concentrated on the production of capital goods in the technologically more advanced industries which would bring greater independence to long-term development. This new process does not necessarily mean that the EEC market will remain one of the pillars of the future expansion of Latin America's mineral resources, for this expansion will depend instead on the following negative factors:

a) Technological progress in the exploration, extraction and processing of minerals will make it possible to exploit deposits which are ignored today or not exploited because of their present low profitability.

b) Submarine technology will make it possible to exploit the multimetal nodules of the seabed.

c) Nuclear fusion will not only provide all the energy needed at a suitable cost but will also open up the possibility of "distilling" rocks to obtain minerals.

The trade relations between Latin America and Japan grew steadily up to 1970 when Japan was taking 11% of Latin American mineral and metal exports, a share which fell to 7% in 1980 but rose again in 1983 (9%). The preliminary figures for 1984-1985 indicate a new drop in the share of the Japanese market. The growth in the first period was due to a degree of complementarity between the two economies and to the dynamism of Japanese investments in the region; this was not true of the irregular performance in the period 1970-1985, which cannot be attributed



either to the general performance of the Japanese economy, the continued expansion of which has enabled Japan gradually to increase its share of the world product.

These variations seem to have been caused not only by changes in consumption and production structures but also by Japan's international economic policy. A very important factor is the impressive technological development of the manufacturing sector in Japan, which has enabled it in a very short time to achieve the productivity levels of the United States and even to surpass them in such important sectors as iron and steel and metallurgy, electrical equipment, electronics and metal manufactures and machinery. This technological progress has brought about a considerable reduction in the mineral and metal inputs per unit of industrial production. Moreover, a large part of Japan's industrial production is for export, so that it has achieved greater flexibility and dynamism in the structural changes of its production without undergoing critical periods of reconversion and adjustment. Technological change has not only been introduced in the new industries but in the basic ones as well. By 1978 the iron and steel industry, for example, already had the following features: a high degree of vertical integration of production with important energy savings; automation and robotization of new plant, with savings in the direct labour employed in new activities; major increases in the production capacity of new plant, which also uses new processes; and reduction of production costs and greater competitive strength in the international market.

Japan's efficiency in international competition is attributed to the co-operation between the government, the financial system and the production enterprises to achieve predetermined targets and objectives; the careful selection of export industries, which are given preferential support in their development; the selection of homogeneous products which can penetrate different markets and make maximum use of economies of scale; the use of sophisticated production methods to maintain the reputation for quality and a proper evolution of prices and profitability; the programming and expansion of foreign investment to increase and utilize the trade surplus; and the great loyalty of the Japanese worker to his company, which prevents

strong wage pressures and major increases in production costs.

It is still uncertain whether the Japanese economy is capable of maintaining its economic supremacy over the coming decades in view of the progress of the other industrialized countries in adjusting their own production structures and of the external dependence of the Japanese economy.

Japan has very high rates of domestic saving and therefore considerable overinvestment in its domestic market consumption; it is therefore vitally important for Japan to place its exportable surpluses in the international market. It must be remembered that in 1985 under external pressure to revalue its currency Japan lost part of its export dynamism with consequent negative effects on its levels of industrial production. On the other hand, Japan's imports are not in proportion to its exports, for it produces everything it can with a view, *inter alia*, to maintaining its low levels of structural unemployment of the labour force. It therefore generates a large trade surplus which enables it to increase its foreign investments, especially to open up new markets for its exports, and this increases the dependence of its production on the international economy. In these circumstances it is not surprising that Japan should advocate a new international division of labour under which it would have to contribute to economic revival by endeavouring to behave responsibly in export trade, by adjusting its export structure, by producing goods and services with greater aggregate value, by diversifying its export markets, and by increasing its imports of manufactures and promoting technological development and economic co-operation (Hosono, 1985).

It is possible that Japan's first initiatives in this direction will be the formation and consolidation of a new process of international development with its highest points in Japan, China and the other recently industrialized Asian countries (towards a macro-market of the Pacific?) which are also directing their economies towards the international markets and have higher growth rates than the growth rates of world exports. Any attempt to consolidate relations with Japan will have to take account of the strong competition from this group of countries which could perhaps form a market of great purchasing

power for future Latin American mineral-based exports since, except in Japan, consumption of these products is still very far from saturation.

Despite the fall in the share of the GDP of the countries of the Council for Mutual Economic Assistance (CMEA) in the world product, their trade in minerals and metals with Latin America grew between 1970 and 1983 as its share in Latin American exports and imports rose from 5 to 7%. The lack of information makes it impossible to assess the changes taking place in the production structures of these countries; however, in December 1985 they approved a technological co-operation programme for the next 15 years in electronics, industrial automation, biotechnology, nuclear energy and manufacture of new materials. These countries have still not reached high saturation levels in their consumption of minerals and metals but, owing to the heavy indebtedness of both groups of countries and the consequent shortage of foreign exchange, the expansion of trade may have to be achieved through compensated trade or barter.

The share of the GDP of the other developing countries in the world product grew from 9 to 13% in 1970-1982; similarly, its share as a market for Latin American mineral and metal exports rose from 1 to 10% in 1970-1983. However, this expansion was due largely to the oil price increase, for the largest GDP growth rates occurred in the countries of the Middle East and North Africa. In any event there must be more systematic exploration of mechanisms to increase South-South complementarity. Priority might be given to the obstacles to increased trade, such as tariff barriers, customs procedures, export financing, means of transport and communication and other infrastructure works such as ports and storage facilities.

The mining crisis grew more acute in the subperiod 1980-1983, affecting the different products in different ways. While for 80% of them production showed decreasing or negative rates, the remaining group not only had positive rates but rates which in some cases were higher than in the previous period. To judge by recent developments, the medium-term prospects for the principal minerals may be as follows:

*Antimony:* As its use is affected by the ups and downs of the motor industry and housing construction, there was very low demand for

antimony in 1983, with a revival between January and May 1984 and a new downturn in June. The market was controlled primarily by South Africa, Bolivia and China. The price is expected to remain unchanged in the medium term. Japan has to import 100% of its needs, the European Economic Community 91%, the United States 51%, and the USSR 20%. The main suppliers in the region are Bolivia, Mexico and Peru.

*Bauxite-aluminium:* The prices of aluminium increased rapidly in 1978-1980 but fell again in 1981-1982. In 1983 the expansion of demand in the United States and Japan, in conjunction with production reductions, led to a decline in stocks and upward pressure on prices. However, the decline in prices during the first half of 1984 is leading to a new situation of overproduction of aluminium. Another reduction in stocks caused prices to rise in the first half of 1986 by 20% over the levels of the last quarter of 1985. Depending on how stocks and the historical consumption trends develop, the prices for aluminium and bauxite may be expected to show an upward trend in the medium term. However, since the profitability of aluminium depends essentially on energy costs and the price of the raw material, there may also be major pressures for bauxite prices to be held down, for they will be determined by the attitude of the main producers (Jamaica, Australia, Papua New Guinea and Suriname). Japan depends on imports of alumina for 31% of its consumption of aluminium and for 100% of bauxite. The import needs of the EEC countries represent 84% of their total consumption of alumina and 28% of aluminium. The corresponding figures are 94% for bauxite in the United States and 60% in the USSR. Given its large reserves, the region could expand its exports considerably, especially in the case of Brazil, Guyana, Jamaica and Suriname.

*Copper:* While the demand for aluminium increased in 1983, the demand for copper remained depressed, with a slight recovery in China as a result of an increase in consumption and stockpiling at the refineries which made it possible to keep prices at levels similar to those of 1982. The recovery between January and April 1984 was cancelled out by the falls in May and June. It is calculated that 1986 demand will decline by 3% over the 1985 levels; however, owing to various

problems, it is assumed that metal production will fall 10%, producing a price increase in 1987. In the medium term there will be a degree of price stability, but prices would rise if demand expanded, owing to supply inelasticity. This rise would be temporary, for marginal deposits would be brought back into production, leading to fresh overproduction. The EEC supplies 67% of its consumption from imports, Japan 87%, and the United States 5%. The region could supply part of this demand with exports from Chile, Mexico, Peru and possibly Panama.

*Columbium:* The European Economic Community, the United States and Japan import all the mineral they need, part of which could be supplied from Brazilian production. An upward trend in prices will be maintained in the medium term.

*Tin:* The crisis has had a heavy effect on tin consumption, which declined between 1978 and 1983 at annual rates of 3%. Although production also declined at similar rates, there was a production surplus over these five years and a consequent increase in stocks. Nevertheless, owing to the regulatory action of the International Tin Council, since April 1984 prices have been in an upward trend which will apparently maintain itself until the end of 1986 as a result of an excess of consumption over production calculated at 15 000 tons. Commercial stocks in the hands of the producers and the International Tin Council are in excess of 80 000 tons, and to them must be added the strategic reserves of the General Services Administration (GSA) of the United States, which are estimated at over 167 000 tons. During the first half of 1986 prices fell by 50% following the collapse of the bufferstock operations of the International Tin Council. It is not easy to determine the short-term movement of the prices of this metal, since the bufferstocks are now in the hands of the creditors (banks and marketing companies) and could therefore be placed on the market at any moment. Furthermore, the price fall has led to the closure of an important group of production companies in Bolivia, the United Kingdom and Thailand, and to reduced production in Brazil. In the medium term it is thought that prices will decline. Japan supplies 96% of its consumption from imports, the EEC 95%, the United States 80%, and the USSR 11%. The region's main exporters are Bolivia and Brazil.

*Fluorite:* The downward movement of demand and prices continued in 1983, although they may recover by the end of 1986 and show no great variation in the medium term, for the United States depends on imports for 85 % of its supplies, the EEC for 18%, Japan for 100%, and the USSR for 47%. The region's main exporter is Mexico, but Argentina and Brazil also have some reserves.

*iron-steel:* In the 1970s and in the first years of the 1980s the price of iron ore was subject to large fluctuations. In 1983 demand fell by 4% and prices by more than 11%; however, there was a large increase in supply. It is thought that during 1986 prices will continue their downward trend and will recover only in 1987-1988. From this date they are expected to remain constant until the mid-1990s. Japan supplies 99% of its consumption from imports, the EEC 79%, and the United States 28%. Latin America has the potential to increase its exports with production from Bolivia, Brazil and Cuba.

*Lithium:* Although demand showed no great fluctuations, prices rose 5% in 1983- Chinese exports increased while those of the USSR declined. The new uses of lithium, especially in electronics, medicine and photography, give grounds for predicting an upward price trend in the medium term. Latin America could increase its exports from Brazilian and Chilean production.

*Magnesium:* The production of metallic magnesium increased by 8% in 1983 and demand by 10%; the difference was made up by secondary production and reduction of producers' stocks. Prices are expected to rise in the medium term. Brazil is operating at somewhat less than 20% of capacity and its production and exports could therefore be increased rapidly.

*Molybdenum:* Consumption was 35% lower in 1983 than in 1979 and prices therefore showed sharp declines. The cutback in production prompted a brief price recovery in 1983, but the large stockpiles again depressed prices in mid-1984. Low prices are therefore to be expected in both short and medium terms. The European Economic Community and Japan depend 100% and 99% respectively on imports of this mineral. The region could increase its exports, mainly with production from Chile, Mexico and Peru.

*Nickel:* After three years of depression demand rose by 10% in 1983 and by a similar

amount in 1984. The gap between demand and production was met from a reduction of stocks which still allowed prices to recover. In 1985 demand and production fell, by 10.5 and 5.6% respectively, leading to a fresh increase in stocks and a price drop. In the first half of 1986 there have been no signs of recovery in demand or production, so that prices are again falling. Nevertheless, prices are expected to remain stable in the medium term. Import needs —80% for the EEC and 72% for the United States— could be met partly from the reserves of Brazil, Colombia, Cuba and the Dominican Republic.

*Phosphate rocks:* In recent years prices showed an upward trend until 1981 when demand stagnated, and production fell until 1983 when demand increased by 12%, production by 9% and international trade by 6%. The increased demand will not keep the installed capacity fully occupied in the next few years, and the prices of this mineral are therefore expected to be stable in the medium term. Import needs (100% for Japan and 99% for the EEC) could be met partly from the reserves of Brazil, Mexico and Peru.

*Selenium:* After several years of overproduction and low prices, the 29% increase in demand in 1983 enabled prices to recover and they will apparently continue to move upwards in the short and medium terms. Import needs (100% for the EEC and 49% for the United States) could be supplied largely from the reserves of Chile, Mexico and Peru.

*Tantalum:* The market had been depressed since 1980, but the 13% increase in demand in 1973 reduced stocks and improved prices. A

demand increase is expected in the medium term, but the production of the main exporters (Malaysia and Thailand) will be held back by the lower production of the co-product, tin. An upward trend in prices is therefore forecast for the medium term. The large demand for imports in the United States (91%), the EEC (100%), and Japan (100%) could be satisfied partly by Argentina but mainly by Brazil.

*Tellurium:* Both demand and prices fell by around 10% in 1983. However, because of its many applications, tellurium is expected to show an upward trend in the medium term. The region's exports come mainly from Peru.

*Titanium (ilmenite and rutile):* Although demand fell by almost 6% in 1983, it is expected to increase in the medium term at annual rates of 5%. The stabilization of prices in the first half of 1984 encourages the expectation that they will be stable in the short and medium terms. Brazil's reserves could meet part of the import demand of the European Community (100%), Japan (100%), and the United States (43%).

*Vanadium:* 1983 consumption levels fell to something like those of 1963, and the situation was made worse by China's export surplus. However, a price recovery began in the last months of 1983. Owing to the extensive use of this mineral by aeronaval industries, the recovery of demand and prices is expected to grow stronger in the medium term. The import demand of Japan and the EEC (100%) and the United States (42%) could be met in part with supplies from Chile and Venezuela.

### III

## Prospects of the regional market

### 1. *The bases for the expansion of the regional minerals and metals market*

If the consumption growth rates of recent decades are maintained in Latin America, it is to be expected that by the end of the century there will be a considerable increase in the region's relative importance as an international demand centre

for minerals and metals. Present imports of minerals, metallurgical products and mineral-based industrial products account for approximately 40% of the region's total imports, and this really does make it possible to achieve rapid substitution of these imports at the regional level. Given the potential of its mining resources, Latin America could produce sufficient sur-

pluses for export not only to maintain its relative share of the international market but also to increase it, for it has competitive advantages in terms of the quality of its mineral deposits, provided that there is a considerable recovery in world demand.

The effects of the crisis on Latin America's mining production is largely the result of its effect on international demand, but the considerable contraction of domestic consumption has also played a part. The annual growth rates of the region's consumption of the main export metallic minerals of Latin America ranged from 2.4% for tin to 11.5% for bauxite in the period 1950-1960. In 1960-1980 the range was from 3.3% for iron to 15.1% for nickel, and in 1980-1983 from -13.3% for copper to -19.9% for iron.

In the period 1960-1980 the annual consumption growth rates for this group of minerals was double the region's corresponding mining production rates in almost all cases, ranging at the upper levels between 50% for iron and 277% for zinc. However, in 1980 the proportion of production for regional consumption varied from 15% for bauxite to 76% for lead. If the gap between the production and consumption growth rates is maintained, it is estimated that by 2000 the majority of Latin America's mineral production could be for the region's own consumption.

Since mineral consumption depends to a large extent on industrial expansion, a more detailed analysis of this consumption will have to include the technical relationships between the two sectors by mining product.

Between 1960 and 1974 Latin America's annual rate of industrial growth was approximately 7%, while the growth rate of mining production was 3.3%. A close correlation ( $R^2=0.78$ ) was generally maintained between the two rates in this period. From 1974 to 1980 this correlation was  $R^2=0.94$  but inversely, for while the industrial sector had a slower rate of expansion, the mining sector increased its growth rate (12.8%), possibly owing to an improvement in its negotiating capacity in the international market, which may indicate that the surplus of mining production in this period had an adequate foreign outlet.

*Copper:* The region's consumption of copper increased at annual rates of 7.3, 7.9 and

-13.3% in the periods 1965-1974, 1974-1980 and 1980-1983; the corresponding rates for production were 3.8, 2.8 and -3.6% with a high correlation coefficient ( $R^2=0.86$ ). It would be true to say that for every 1% increase in copper production, consumption increased at rates of between 2 and 4%.

*Tin:* The regional consumption increased by 4.1 and -3.1% a year in 1965-1980 and 1980-1983; the corresponding production rates were 2.0 and 0.9%. Since the correlation coefficient between consumption and production is relatively high ( $R^2=0.64$ ) it is to be expected that for every 2% increase in consumption, production increases by around 1%.

*Iron:* In the period 1965-1974 the region's consumption and production growth rates for iron ore were 7.4 and 11.7% respectively. In 1974-1980 they fell to 2.8% for consumption and -4.7% for production; in 1980-1982 consumption was 19.9% and production 8.2%. With a correlation coefficient of  $R^2=0.64$  it is to be expected that for every 2% increase in consumption, production increases by around 1%.

*Nickel:* Nickel consumption and production in the region are in a downward trend, for the annual consumption growth rates declined from 20.9% in 1965-1974 to zero in 1980-1983, while the production growth rates fell from 11.3 to -4.1%. With a high correlation coefficient ( $R^2=0.87$ ) it is reasonable to expect that for every 2 to 4% increase in consumption, production increases by around 1%.

*Lead:* The regional consumption of lead is also in a downward trend, with annual rates of 6.9% in 1965-1974, 1.7% in 1974-1980, and 8.1% in 1980-1982; the production rates were 2.5, 4.6 and 9-8%, with a very low correlation between production and consumption ( $R^2=0.17$ ).

*Zinc:* The region's consumption and production showed a downward trend with negative rates in the period 1980-1983. The high correlation coefficient ( $R^2=0.92$ ) means that every 1% increase in production should be followed by a 3% increase in consumption.

Latin America's share in world consumption of minerals in the period 1980-1981 was very uneven, ranging from 0.2% for tellurium to 23.6% for platinum. Per capita consumption ranged from 2% for uranium to 84% for manga-

nese as proportions of the per capita consumption levels of the developed countries in 1980.

The possible levels of per capita consumption of minerals in Latin America by 2000 has been calculated on the basis of the following assumptions: a) consumption will increase by 50% over its 1980 levels for the products which in the base year (1980) accounted for 15% of the per capita consumption of the developed countries; by 75% for the products which represented between 16 and 50%; by 100% for the products in the 51 to 75% range; and by 100% for the products which represented more than 75% in the base year; b) proportionate adjustments have been made in the cases in which world consumption exceeded estimated reserves for 1983; and c) total consumption was estimated on the basis of an annual rate of population growth in Latin America of around 2.4%

On these assumptions, the annual growth rates of per capita minerals consumption in Latin America by 2000 would be as follows:

Minerals	Growth rates
Traditional non-ferrous metallic	0.05% (tin) to 2% (copper)
Traditional ferrous metallic	0.02% (vanadium) to 14.7% (tungsten)
Alloys and refined	1.1% (asbestos) to 2.1% (fluorite)
For electrical use	0.3% (tellurium) to 7.8% (cadmium)
For chemical use	1.3% (bismuth) to 57.0% (phosphate rocks)
Light metals	0.3% (rutile) to 82% (bauxite-aluminium)
Precious metals	0.2% (platinum) to 2.3% (silver)
Radioactive metals	Uranium (0.03%)

It must be remembered that consumption refers to the industrial use of minerals and metals (intermediate consumption) and not to final consumption which also includes the minerals and metals found in the net imports of manufactured, semifinished and final-use products. Furthermore, a large part of the regional effort should be concentrated on production, with a view to substitution of imports from outside the region which in 1982 totalled more than US\$ 46 000 million (tables 5, 6 and 7).

If the forecasts of consumption and export substitution prove correct, mining production will have an annual growth rate of about 4% up to 2000. Consumption, which at present amounts to about 20% of production, will amount to 75% in that year.

Table 5

### LATIN AMERICA: IMPORTS FROM OUTSIDE THE REGION

(Thousands of millions of dollars)

Minerals and concentrates	0.6
Metals	4.1
Semi-finished products	1.4
Final-use products	40.0
Total	46.1

Source: ECLAC, Latin American Foreign Trade Data Bank (BADECEL).

Table 6

### LATIN AMERICA: SHARE OF IMPORTS

(Percentages)

	Minerals and concentrates	Metals	~ finished <sup>a</sup>	Total
Argentina	0.5	4.1	1.6	6.2
Bolivia	-	0.5	0.2	0.7
Brazil	3.1	7.4	4.1	14.6
Colombia	0.7	5.6	1.7	8.0
Costa Rica	-	0.5	0.2	0.7
Chile	0.4	0.9	1.1	2.4
Ecuador	0.1	1.8	0.7	2.6
El Salvador	0.1	0.3	0.2	0.6
Guatemala	-	1.2	0.5	1.7
Honduras	-	0.4	0.2	0.6
Mexico	4.2	17.9	6.0	28.1
Nicaragua	-	0.5	0.2	0.7
Paraguay	-	0.1	0.2	0.3
Peru	0.2	2.4	1.4	4.0
Uruguay	0.1	0.2	0.1	0.4
Venezuela	0.8	22.9	4.7	28.4
Total	10.2	66.7	23.1	100.0

Source: ECLAC, Latin American Foreign Trade Data Bank (BADECEL).

**Table 7**  
**LATIN AMERICA: INTRA-REGIONAL**  
**TRADE IN 2000**

(Percentages)

	Exports	Imports
Argentina	<b>0.6</b>	15.2
Bolivia	12.3	2.0
Brazil	10.6	10.9
Chile	41.2	<b>6.4</b>
Colombia	2.3	0.2
Cuba	<b>5.3</b>	3.2
Jamaica	<b>6.7</b>	<b>0.7</b>
Mexico	<b>0.7</b>	<b>19.1</b>
Peru	14.0	12.6
Dominican Republic	2.3	0.2
Venezuela	0.3	9.4
Other countries	<b>3.7</b>	20.1
<b>Total</b>	<b>100.0</b>	<b>100.0</b>

Source: ECLAC (1985), table 24.

**Table 8**  
**LATIN AMERICA: INCREASE IN**  
**RESERVES UP TO 2000 AND**  
**PROBABLE INVESTMENTS**

	Required reserves (thousands of tons)	Distribution of probable investments (percentages)
Asbestos	7 700	8.1
Baryta	33 400	1.9
Cobalt	100	1.2
Chrome	26 400	39.0
Ilmenite	7 800	7.1
Manganese	91 500	13.6
Mercury	20	0.3
Gold	3	20.1
Silver	1	7.1
Rutile	30	1.6
<b>Total</b>		<b>100.0</b>

Source: ECLAC, (1985), table 24 in the statistical annex.

Given the ratios between consumption, production and reserves in the various regions of the world, Latin America could have relative advantages in and generate exportable surpluses of antimony, bismuth, cadmium, copper, tin, fluoride, iron, lithium, molybdenum, silver, selenium and zinc. These exports to countries outside the region would represent around 25% of production.

To achieve self-sufficiency in minerals as well as exportable surpluses, the region would have to increase the mineral reserves listed in table 8, with a probable investment of US\$ 30 000 to US\$ 35 000 million.

The total investment for the whole period is calculated at around US\$ 80 000 million for the phases of mining and extracting metallurgy; this financing could be provided by possible exportable surpluses, which could even generate a financial surplus equivalent to 95% of the investment. Table 9 shows the hypothetical dis-

**Table 9**  
**LATIN AMERICA: HYPOTHETICAL**  
**DISTRIBUTION OF INVESTMENTS**  
**AND NET FLOWS OF FOREIGN**  
**EXCHANGE UP TO 2000**

(Percentages)

Country	Distribution of total investments	Net flow of foreign exchange
Argentina	1.3	(28.8)
Bolivia	5.3	38.7
Brazil	46.7	29.0
Chile	13.2	93.0
Colombia	5.0	0.1
Cuba	2.8	9.5
Jamaica	1.4	9.9
Mexico	14.0	(39.2)
Peru	7.0	27.1
Dominican Republic	1.0	3.1
Venezuela	0.6	(10.1)
Other countries	1.7	(3.2.3)
<b>Total</b>	<b>100.0</b>	<b>100.0</b>

Source: ECLAC (1985), table 24.

tribution on the basis of the mineral reserves in the countries of the region.

However, the greater commitment with respect to investment and technology will have to be made in processing metallurgy and production of semifinished goods and final-use manufactures. To give an example of the order of magnitude, the per capita consumption of aluminium of the developed countries and Latin America was 13 kg and 1.6 kg respectively in 1980. If the forecast for 2000 is an increase in regional

consumption to 7.5 kg, total production would have to increase by 3.2 million tons, which would mean the construction of some 15 foundries, as well as processing plants for sheet metal, bars, pipes, sections and final-use products. Given the same assumptions, iron and steel production would have to increase from 20 million to 100 million tons in the period 1980-2000, which would mean an annual investment of some US\$ 10 000 million. The same is true for copper, nickel and the other minerals.

## IV

### The basic action lines

The challenge to the region to satisfy the growing needs of its domestic market and maintain its share of international supply in these products, will call for a technical, economic and financial effort of such magnitude that it can only be achieved through joint action by all the members of the mining, metallurgical and industrial sector. This action should be concentrated on joint activities, studies and projects, and this implies initiatives both from producer enterprises and service enterprises and institutions and from the bodies which formulate and implement mining industry policies in the countries of the region.

The Latin American countries have to cope with technological changes in a context of economic recession, foreign debt, shortage of capital equipment and cutbacks in public expenditure. The financial institutions are conservative in their analysis of projects for technological change, and institutions will have to be established to enable the region to cope with the problems and take advantage of the opportunities which arise in a world of changing needs and characteristics. The first steps have already been taken with the creation of the Latin American Mining Organization (OLAMI).<sup>1</sup> Owing to the lack of financial resources, OLAMI does not yet

have the permanent staff it needs to attain its goals, and the national co-ordination units are engaged in completing their various stages of organization. However, this institution could be used in Latin America by the mining and metallurgical sector as a forum for consultation and exchange of information and primarily as a coordinator of the basic operations which have to be carried out.

#### 1. *The diversification of mining production*

Over the past 10 years there has been a marked tendency for production to increase, but proper ratios between reserves and annual production have not been maintained owing to the large amount of risk capital involved in prospecting and exploration. The minimum acceptable is a ratio of 10 to 1, and even this would produce critical levels by 2000 in the case of 20 products. However, according to the analysis which has been made, if Latin America is to adapt the structure of its mining production to the changing conditions of regional and world demand, it is essential to redefine the strategic value of mining and metallurgical activities. Instead of the present concentration of production on a few widely produced minerals, an extremely diversified structure will have to be established, even though in the majority of cases the production volumes would be only small or average. To achieve this it will be necessary to initiate joint

<sup>1</sup>See in this issue the article by Michael Nelson entitled "Technology transfer in the mining sector: options for the Latin America Mining Organization (OLAMI) .



action to produce a more comprehensive picture of the region's mining potential and to organize production and marketing enterprises for the new minerals. A series of activities is therefore proposed for the establishment of a Latin American system of geological mining research and the formation and development of new enterprises with a view to diversification of Latin America's mining production structure.

a) *Latin American geological mining research system*

The volume and distribution of known mineral reserves, together with the facility of access to them, are the main physical factors determining the feasibility of expanding the region's productive base. Mineral reserves must be constantly re-evaluated, not only in the light of increased knowledge of the size of the deposits but also in terms of their economic value, which in turn depends directly on prices and inversely on production and marketing costs.

Knowledge of the region's mining potential is generally inadequate and only small portions of the territory have been intensively explored. The information is not all of the same quality and in some cases it is unreliable. The majority of the region's countries have basic geological maps; progress has also been made in identifying the main deposits and preparing metallogenic maps, although much hard work remains to be done to complete the preparation of such maps for the whole region.

The complexity of the problem means that resources and efforts must be concentrated on prospecting and exploration through joint regional initiatives; for this purpose it is proposed that a multigeological, multinational and multidisciplinary team should be set up at the regional level with the following main functions: preparation of common criteria and methodologies for classification of deposits; assembly of existing information or preparation of an inventory of the region's mineral reserves and resources, which should be constantly reassessed and updated; multiple-correlation analysis for the selection of goals and geographical areas in a priority programme of mineral prospecting and exploration; preparation of a priority regional programme of mineral prospecting and exploration; formation of binational or

subregional teams to carry out under the central team's co-ordination the activities of the regional prospecting and exploration programme; and generation of new research to produce metallogenic interpretations to promote further mineral prospecting and exploration operations.

It will also be necessary to carry out a regional mineral prospecting and exploration programme to identify the deposits of better quality and easier access, so as to minimize the risks for future investments; to identify the mineral-bearing provinces and districts; to determine production specialization by geographical area and prepare prefeasibility studies or projects on the geologically most promising possibilities.

The purpose of the establishment of regional consultancy and engineering enterprises specializing in mining projects would be to identify and determine the comparative advantages of the region's new mineral deposits; to determine the possible sources and forms of financing for the mining projects and the markets and forms of marketing of the new products; to design the machinery and equipment to be used in mining production and metallurgical operations in the light of the possibilities of the regional industry; to prepare feasibility projects for subsequent consideration by financing bodies; to define criteria and methodologies for the preparation of project descriptions and the formulation, evaluation and implementation of mining projects; and to advise and train the staff required for the various activities of business management and administration of technological processes.

b) *formation of new enterprises*

As far as possible, the sector should encourage enterprises which base their operations on small high-quality deposits of valuable minerals, which can go into production relatively quickly with low capital requirements and which can use intermediate technologies capable of being produced in the region. Although application of this set of requirements will mean the elimination of a number of projects, it must be remembered that given the region's financial situation and the intense competition in the international market, projects which meet these requirements will be the only ones to guarantee any great benefit for the countries of the region.

The formation of intra-regional joint enterprises (State and private) would be justified in order to avoid competition among the region's enterprises; to reduce operating costs by economizing on certain inputs which would be duplicated if the enterprises worked independently; to reduce expenditure on various items not directly connected with production costs, such as staff training, research, publicity, marketing, purchasing and other administrative matters; to achieve production complementarity or integration of mining, metallurgical and industrial activities; and to encourage the mobilization of the regions' financial resources and share purchases.

One way of mobilizing the region's financial resources for mining projects is to spread investment possibilities as widely as possible among medium-sized or small enterprises; this can be done directly or through the stock markets or the banking system acting as trustees or guarantors of share issues. Tests of pilot plants have shown that such enterprises are economically viable, and manuals are being prepared which establish the methodologies for evaluating their feasibility. However, in practice their formation and development would require the assistance of various services, such as training, technical and administrative advice, subsidiary processes in the purchase, processing and marketing of the minerals and start-up loans.

Another important aspect is the adaptation of mining machinery and equipment to the production conditions and characteristics of small and medium-sized enterprises. Two solutions are available here: to design the machinery and equipment as a joint operation with the region's manufacturers which produce these goods; or to bring in enterprises from other countries of the region with a view to agreements on transfer of technology or mutual industrial assistance in a process of horizontal co-operation.

The sector's new investment needs represent a considerable challenge in the present situation of financial crisis resulting from the region's external debt. The multinational promotion bodies could help in this task through co-financing and other promotional operations. It must be remembered that direct investment can produce better conditions for the transfer of technology and penetration of difficult markets.

It would also be possible to use other sources of credit in the financial world, such as suppliers' credits, insurance funds and export credits, investment guarantees, advances from commercial intermediaries and pension funds.

In view of its financial situation Latin America must examine very carefully the inputs of foreign investment which may be considered necessary for the region. A first step would be to define the points of convergence of the interests of the regional enterprises with those of transnational corporations, with a view to establishing the conditions for stable relationships of mutual advantage. Furthermore, the participation of the governments of the region in these joint enterprises could reduce the political and economic risks of mining investment. Agreements could be established between the region's mining and metallurgical enterprises and transnational industrial enterprises, with a view to the manufacture in Latin America of semi-manufactures for the regional market. In view of the difficulties of finding venture capital, it is proposed that the State should participate jointly with financial bodies and mining enterprises in the formation of a pre-investment fund through purchases of shares which would be redeemable or could form part of the capital of profitable projects.

## 2. *The vertical integration of production*

The mining controversy is characterized not only by divergences among the goals and interests of exporters and importers but also by the need to integrate mining activities with the activities of the metallurgical and final-use industries; this process is essential if the mining products are to reach the consumer.

In the first half of the century, the process was facilitated by transnational production companies holding mining concessions in the countries exporters of raw materials and possessing metallurgical and industrial plant in the countries producing manufactures. Although these activities were not integrated in a single country, the process was guaranteed by the concentration of the factors of production in the hands of the transnational production corporations.

The small share of the mineral-exporting countries in the profits from this production

process determined at a later stage their strong aspiration not only to exercise more fully their sovereign rights over their natural wealth but also to participate directly in the production process. The successive nationalization of mining enterprises led to the segmentation of the production process between mining-metallurgical producers located in the mineral-exporting countries and the producers of metallurgical and mineral-based manufactures in the importer countries. Furthermore, as the international market prices referred to metals, which are homogeneous products, and not to minerals, which are differentiated products, there was a clear need for marketing agents or intermediaries to "integrate" the mining product with the metallurgical and manufactured products.

The need to redirect the region's mineral production towards its own market implies the gradual achievement of higher levels of integration of mining, metallurgical and industrial activities, both for the substitution of exports from outside the region and for the new expansion of productive capacity and regional consumption. Generally speaking, this process is moving ahead in Latin America from the production of minerals and concentrates to the production of metal goods (foundries and refineries) which have the highest prices in the international market. However, a great investment effort must still be made if mining production is to be processed totally into production of smelted and refined metals (table 10).

There is also a wide gap between the production of smelted and refined metals and the demand from the capital goods and final-use industries, since they prefer to use intermediate or semi-finished goods such as sheets, bars, pipes, sections and wires.

A number of joint initiatives will have to be taken if this production process is to be integrated. Two of the basic obstacles to greater integration of activities are the minimum economic scale of production of each of the intermediate goods and the smallness of the national markets, where absorption levels are lower than production capacity. Measures concerning the free transit of these products should therefore be given highest priority.

With the technology developed in recent years it is possible to design plants which inte-

grate the production process from the extraction of the mineral to the production of iron and steel or semi-finished goods. These new forms of production mean a considerable saving on the costs of energy, transport and administration. The measures should be aimed at encouraging mining industry development on the basis of integrated plants.

Table 10

**LATIN AMERICA: INVESTMENTS  
REQUIRED FOR THE PROCESSING  
OF MINING PRODUCTION**

	Minerals production (thousands of tons) 1983	Production requiring new investments for metal processing (percentages)
Bauxite- aluminium	17 000	64
Copper	1 800	39
Tin	41	40
Iron-steel	120 500	70
Nickel	47	30
Lead	470	19
Zinc	1 044	58

Source: UNIDO (1984).

The region has various sectoral agreements, the implementation of which, directly or indirectly, could require mineral inputs, such as the Cartagena Agreement (metal manufactures and machinery, petrochemicals, automotive, and iron and steel). Meetings should be convened with the industrial enterprises to which production has been assigned in order to discuss with them the possible associated forms in which the mineral and metallurgical inputs could be furnished.

In recent years the markets of the developed countries have been fairly successfully penetrated by metal-based final-use or semi-finished products from several developing countries, including for example special steels from Brazil. The greater integration of these activities would

invest the manufactured product with the comparative advantages of the region's rich mineral deposits. This proposal implies an integration procedure "from the top downwards", i.e., the first step would be to identify the manufactures with an assumed regional or international demand, and the joint production of the mineral inputs would be programmed at a later stage. In this way the integrated mining-industrial plants, with lower costs and production volumes, would be able to compete with the economies of scale of plants with larger production volumes, and they would have the additional advantages that small and medium-sized enterprises are more responsive to changes in demand and adapt more easily to technological innovations.

It is very likely that in the market of the future comparative advantages will no longer be determined by the relative supply of capital, labour and natural resources but rather by the mastery and application of scientific and technological knowledge. Diversification of production, reduction of costs and vertical integration have the common denominator that the strategic input for their attainment would be the adoption of suitable technological processes. Latin America already has in the mining and metallurgical sector a large stock of technological knowledge scattered among the various countries, organs and enterprises of the region: it should therefore give special priority to the operation of various mechanisms for the widespread dissemination of this knowledge. This includes, for example, the implementation of specific horizontal co-operation projects between enterprises and institutions of the region and the establishment of a permanent system for the exchange of information. The large financial and staffing requirements of technological research have prompted the OECD and CMEA countries to sign long-term agreements for the implementation of various technological research operations. Latin America should also give first priority to the formulation and implementation of integrated programmes of technological research. It should, for example, carry out studies to identify the training and staffing needs and the region's capacity to meet these needs; to determine the general characteristics of the region's supply and demand with respect to production processes and mining and metallurgical

machinery and equipment; and to determine the implications of the transfer of technology involved in direct foreign investments.

### 3. *Intra-regional trade in mining products and inputs*

In the period 1970-1980 exports of minerals and metals from Latin America to the region itself grew at a higher annual rate (21.4%) than in the rest of the world (12.8%), so that Latin America's share in the total rose from 6.4 to 12.4%. There was a reversal in 1980-1983 when intra-regional trade in these products declined at annual rates of -17.5%, while trade with other regions fell by -2.8%, so that Latin America's share dropped from 12.4 to 8.0%. For the same reasons, its share of imports of minerals and metals from the region itself increased from 10.7% in 1970 to 14.6% in 1980, only to fall to 10.6% in 1983.

In order to overcome this low and declining share in intra-regional trade, joint action is required under the auspices of OLAMI in order to create a system with the basic objective of promoting gradual regional self-sufficiency in minerals, metallurgical products and mineral-based manufactures, a system which would perform the following main functions: identify and publicize new opportunities of intra-regional trade; publicize on an ongoing basis the mechanisms for exports promotion and compensated trade; co-operate in the establishment of trade complementarity agreements; promote the formation of processing and marketing companies or systems for the minerals produced by small and medium-sized enterprises; propose purchasing procedures for State bodies; encourage the organization of a Latin American exchange for the purchase and sale of metals; and study the comparative advantages of the various mining, metallurgical and industrial enterprises of the region in order to encourage their specialization.

With respect to compensation agreements, the modality of compensated trade could take different forms in transactions between enterprises. One form might be the barter of imports of similar value produced by one enterprise and needed by another. This might mean the immediate exchange of one commodity for another or the immediate delivery of one of them (for

example, machinery and equipment) for the future production of the other (for example, metallurgical products manufactured with the machinery and equipment received earlier). Another form of transaction would be the exchange of an input required by an importer enterprise (for example, mining machinery and equipment) for the whole of a group of commodities with high demand in the country of the exporter enterprise or in the international market. In this case the mining enterprise and the industrial enterprise have to act directly or through marketing intermediaries as purchasers and vendors respectively of the package of commodities which are exchanged for the machinery and equipment required by the mining enterprise.

Compensated trade procedures are already being used in the acquisition of capital goods from the United States and Europe in exchange for the 33 commodities which are today given future quotations, consisting of metals, petroleum and agricultural products. However, this trade flow would not be fully meeting the basic objectives of the compensation agreements, which in the case of Latin America are designed to achieve fuller utilization of the region's installed productive capacity, to revive intra-regional trade without substitution of the trade at present carried on through the traditional machinery, and to generate or economize on the region's foreign exchange.

It is clear that the enterprises and organs involved in the compensation agreements would have to obtain the necessary exemptions from the regulations concerning exchange controls, tariffs and taxes and other non-tariff restrictions. Another serious problem to be solved is the financing and guaranteeing of the export and import operations. In the case of companies in the ALADI countries these kinds of transaction are governed by the Agreement on Payments and Reciprocal Credit of the central banks. This Agreement establishes a multilateral mechanism for clearing the bilateral trade balances every four months; the Central Reserve Bank of Peru is the body responsible for the accounts. This agreement is supplemented by the Santo Domingo Agreement on financing of the system's deficits or extension of credit between central banks when transactions are completed in different periods. It must be remembered that

both the Payments Agreements and the Bilateral Credit have maximum limits. The need for financing beyond these limits and transactions outside ALADI and the region would require the establishment of another insurance and financing fund for mining, metallurgical and industrial products connected with these activities.

Accordingly, a system of trade and financial complementarity and the compensation agreements on mining, metallurgical and industrial activities could perform the following functions: processing of information on the supply of manufactures (machinery, equipment and inputs used by the mining and metallurgical sector) and distribution to possible purchasers; preparation and distribution of information on the supply of mining and metallurgical products; promotion of contracts for the sale of manufactures in exchange for mining and metallurgical products; processing of minerals at the request of the industrial enterprises, under processing contracts and through the sale or export of the mining and metallurgical products received by this business group through triangular trade transactions; integration of the production process of the region's existing plants or integration with those of other regions in order gradually to eliminate trade intermediaries through arrangements for partnerships of mining companies and metallurgical companies and of metallurgical companies and companies producing semi-finished or final-use goods; promotion of the purchase or import of the output of this integrated process; and formation and administration of an exports insurance system to guarantee and finance export-import transactions involving mining, metallurgical and industrial goods, adjusting any deficits that may be produced.

The majority of the countries of Latin America publish annual reports on their mining activities. However, they differ from country to country in terms of their application, scope and type of data. The specific features of these information systems prevent their homogenization over the whole region. There is a need therefore to systematize the sector's information and documentation and to standardize the statistics and relevant quality data. Regular information should also be furnished about forecasts, production capacity, demand movements and other market conditions to help the region's mining enterprises to make fairer agreements concer-

ning investment, production and marketing.

The information system should assemble the information in a data bank and arrange for its exchange and publication, initially covering the following points: preparation and constant updating of a directory of mining and metallurgical enterprises and related industries and institutions; publication of the balances of the products offered and required by mining and metallurgical enterprises and related industries; collection and exchange of information and the results of geological-mining correlations; collection of information for the formulation of integrated programmes of technological research; preparation and training of human resources and establishment of technological standards and procedures for mining and metallurgical production; permanent maintenance of an inventory of preinvestment or investment pro-

posais and projects; preparation and permanent updating of finance sources and institutions and preparation or publication of the corresponding procedural manuals; and exchange of information on the terms of investment contracts, business management, marketing and transfer of technology.

Lastly, consideration should be given to the possibility that one of the richest sources of proposals and initiatives for regional integration may be the governments, institutions and enterprises themselves, usually in the form of bilateral offers of technical and economic co-operation. It is to be hoped that, promoted and co-ordinated by OLAMI, horizontal co-operation projects will be generated and implemented on such a scale that they will become one of the main tools for the development of the region's mining resources.

### Bibliography

- Association of Geoscientists for International Development (1986): *Agid News*, January.
- Council on Environmental Quality and the Department of State (1980): *Global 2000 Report to the President; entering the Twenty-First Century*. Gerald O'Barney, Study Director. Washington, DC: us. Government Printing Office.
- ECLAC (Economic Commission for Latin America and the Caribbean) (1986): *La relación de intercambio de los productos primarios de América Latina y el Caribe (Lc/L.382)*. Santiago, Chile.
- (1985): *Desarrollo de los recursos mineros de América Latina. Estudios e Informes de la CEP AL*. No. 48. Santiago, Chile, July. United Nations Publication, Sales No.: No.:S.85.II.G.5.
- Hosono, Akio (1985): *Transformaciones económicas del centro y sus implicaciones para América Latina. El caso del Japón*. Conference Room Paper No. 11. Expert meeting on crisis and development in Latin America and the Caribbean, ECLAC, Santiago, Chile, 29 April to 3 May.
- Leontief, Wasily (1977): *The future of the world economy: a study study on the impact of prospective economic issues and policies on the International Development Strategy*. New York: United Nations.
- OECD (Organization for Economic Co-operation and Development) (1979): *Facing the future: mastering the probable and managing the unpredictable*. Paris: OECD. INTERFUTURES project.
- UNIDO (United Nations Industrial Development Organization) (1980): *Mineral processing in developing countries*. New York, United Nations Publication, Sales No.: E.80.II.B.5.
- United Nations (1984): *Monthly Bulletin of Statistics*, Vol. XXXVIII, No. 5, May.