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Notes and explanation of symbols

The following symbols are used in tables in the *Review:*
Three dots (...) indicate that data are not available or are not separately reported.
A dash (—) indicates that the amount is nil or negligible.
A blank space in a table means that the item in question is not applicable.
A minus sign (-) indicates a deficit or decrease, unless otherwise specified.
A point (.) is used to indicate decimals.
A slash (/) indicates a crop year or fiscal year, e.g., 1970/1971.
Use of a hyphen (-) between years, e.g., 1971-1973, indicates reference to the complete number of calendar years involved, including the beginning and end years.
Reference to "tons" mean metric tons, and to "dollars", United States dollars, unless otherwise stated.
Unless otherwise stated, references to annual rates of growth or variation signify compound annual rates.
Individual figures and percentages in tables do not necessarily add up to corresponding totals, because of rounding.

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The technological potential of the primary export sector

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This study makes an appraisal of the impact of technological change on the Latin American commodity sector, especially with regard to demand. It examines the factors underlying the apparently declining raw materials demand in developed countries and threatening to affect demand in developing countries as well. In this context, the process of materials substitution and the relationship between commodity demand and economic development are analysed from the standpoint of use-intensity, and the hypothesis is put forward that the threat posed by a reduction in materials demand in the North via "de-materialization", economies and substitution could perhaps be mitigated by increasing materials requirements in the South by means of population increase, infrastructure works, consumerism and appropriate government policies. The region still has areas not fully exploited with the existing technologies whose potential could be substantially enlarged by changing or improving the prevailing production structure. This proposition is tested in four strategic areas (increasing the technological content of exports, intensification of local processing, redirection of commodity trade inwards to the region itself and strengthening of marketing and product promotion infrastructures).

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Introduction*

One of the major issues on the international commodity sector relates to the proposition that there has been a significant downward trend in the prices of primary goods, at least in the period since the Second World War. This virtually established proposition[1] is now overshadowed by the recently growing concern that raw materials demand in the developed market economy countries (DMECs) has been slowing down considerably and that the very factors responsible for this would soon begin to affect the developing countries' demand to such a degree that the world consumption of materials and thus the future prospects of commodity-producing countries would be seriously restricted.

The reasons for believing in a long-term deterioration in commodity prices from the Third World perspective are well known. They include low prices and poor income-elasticity of the demand for commodities as compared with manufactures, and the asymmetric impact of trade-union power in developed countries and labour surplus in developing countries on the division of the benefits of increased productivity. In addition to these familiar factors, other structural elements have gained increasing importance in recent years.

Deep in the process of structural transformation in commodity demand there are said to be at least three factors at work: i) the general shift of GDP towards the service sector, which commonly consumes a smaller volume of raw materials than the manufacturing sector; ii) the "de-materialization" of production processes which consists of a shift in the composition of demand away from the products of industrial activities which consume more raw materials; and iii) the reduction or eventual elimination of the raw materials consumed in the manufacture of existing or emerging products through *substitution* of other materials in those products and

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[1]Recent studies (Sapford, 1985; Grilli and Yang, 1988), though not necessarily agreeing on the magnitude of the decline, support the proposition originally advanced by Prebisch (1950) and Singer (1950 a) of the longstanding price deterioration.

through more intensive or more economical use of the materials: *materials saving* or *materials economy*. Reduced growth in the demand for traditional metals and some agricultural products result from the interaction of these factors. On the supply side, the most remarkable developments have been the accelerated production of a number of commodities, particularly agricultural ones, and continuous improvements in productivity, both in developed and in developing countries, through the use of new production technologies.[2]

The emergence and spread of new technologies have a strong bearing on the export prospects of developing countries. While the competitive advantages deriving from the abundance of natural resources and manpower in these countries may be eroded by these technological changes, they also offer new production and export opportunities if they are developed in time and properly exploited. Which of the two scenarios is more probable is a question of great socioeconomic importance, particularly for Latin America and the Caribbean, whose exports consist mainly of commodities and whose manufacturing sector has a strong commodity-based bias.

The scope of the term "new technologies" is diverse and encompasses a broad range of activities (see UNCTAD, 1984). The new developments most often cited are microelectronics, biotechnology and materials technology. The use of microelectronics in a great variety of activities reflects its penetration capacity and its main use in the commodity sector has been in agriculture (for example, irrigation, livestock supervision and crop control). With microelectronics, production processes have become highly automated, and in most cases more capital-intensive, producing an impact on demand and supply, not only in production itself but also in efficiency gains in stock management and other administrative reorganization procedures.

The so-called information revolution has also had a strong impact on the financial aspects of the commodity sector. High-speed and cheaper data processing has facilitated portfolio selection among a variety of financial products and commodities. It also has facilitated the introduction of "programme trading". The worldwide round-the-clock trading system organized for gold, petroleum, bonds, stocks and commodities has encouraged institutional investors to try to make profits by revolving their funds in a very short time, making commodity prices more volatile.

In biotechnology, besides the traditional biological processes (bread, cheese, beer, wine, etc.), the latest advances in molecular biology, biochemistry and microbiological genetics have found extensive laboratory applications, some of them on a commercial scale. The most decisive impact of biotechnology development should be in agriculture, with crop farming alone accounting for more than 60% of the potential market, estimated at US$50 billion a year (Ahmed, 1988). In agriculture, in almost every aspect of cash crops, there are tantalizing prospects of improving the yields, the production based on renewable resources, and human welfare. Bioprocessing in the areas of synthetic fuels, materials recovery (for example, minerals recovery in mining by "bacterial leaching") and elsewhere has a broad range of actual and potential applications.

Materials technologies, such as those used in fine ceramics, optical fibres, plastics[3] and composite materials, have led to improvements in the quality of many products and to lower manufacturing costs by saving energy and material inputs, reduced weights, increased scope for manufacturing activities in small and medium-

[2]It is important to note that the factors which seem to have gained importance in recent years did not escape the critical eyes of Prebisch (1951) and H.W. Singer (1950b). As early as 35 years ago, they pointed to a possible decline in demand for commodities due to technological changes leading to a reduction in the raw materials intensity of certain production processes and to competition from synthetics and substitutes.

[3]A most notable product replacing traditional non-fuel materials is plastics. On a volume basis, the United States consumption of plastics now exceeds that of steel, copper and aluminium combind. It is known that at least one-fourth of all plastics and resins produced in this country displace non-fuel mineral materials. Polymer materials have already replaced about 7% to 9% of the steel consumed in domestic motor vehicle production and may displace more than double that amount by 2000. In the construction industry, it is estimated that polymers have replaced slightly less than 10% of the steel consumed and by 2000 could displace as much as 13%. (Fraser and others, 1987.)

sized markets, and, most importantly, increased invention of new products. These new materials technologies are believed to encourage the displacement of traditional materials (for example, optical fibres vs. copper in telecommunications,[4] fine ceramics, plastics and composites vs. steel and aluminium in car manufacturing), but they also create a new demand for certain commodities.

As some studies (Pérez, 1986, UNCTAD, 1986 c) suggest, the socioeconomic impact of new technologies will differ according to the extent to which the technology in question influences the existing "techno-economic" system. Allowing for the danger of oversimplification and their possible interrelation, there are at least three distinct categories of technological change: i) *gradual innovation,* entailing small improvements in the existing array of processes and products in different industries; ii) *radical innovation,* entailing the development of fundamental new materials such as polyethylene or completely new products such as optical fibres, fine ceramics, etc.; and iii) *technological revolution,* such as the introduction of steam power, internal combustion engines, electricity, Bessemer steel production, mass-production assembly lines, microelectronics, and possibly superconductivity, which have all entailed or are expected to entail profound and far-reaching production changes throughout the economy. The present study focuses mainly on the first two categories, which have had a pervasive impact so far on the raw materials exports of developing countries, but it by no means underestimates the significance of the third category of technological development for the prospects of the international commodities sector.

I

Nature and characteristics of world technological change and its impact on commodity demand and supply

This paper focuses mainly on technological changes affecting the demand for commodity exports from developing countries. This approach to the subject therefore leaves out a wide range of changes on the supply side. Although such issues as the impact of technological change on production through improved productivity or the creation of new products or production methods are complex in nature and too many in number to be fully documented here, some illustrative cases are still worth mentioning.

1. *Technological developments on the supply side of commodities*

a) *Minerals and metals*

In the mining and metal-working sectors, apart from the advances in mineral exploration, most of the new technologies currently in use have emerged or have been improved during the last decade, after the first oil price increase, in order to save energy, reduce operating costs and improve quality. These innovations, in turn, have had two major effects: on the one hand, they have made metals more competitive, thereby resisting the loss of segments of their traditional markets threatened by economic recession and the growth of substitutes; and on the other, they have achieved savings raw materials in the production and manufacturing stages.

Developments in the iron and steel industry are instructive. The technology of the processing

[4]Some experts predict that the displacement of the copper market by optical fibres in the six DMECs (United States, United Kingdom, Federal Republic of Germany, France, Italy and Japan) by about 230 000 tons by 1990 and a little over 300 000 tons by 1995, is equivalent to 4.3% and 5.6% respectively of the total copper consumption that would have been projected for these six countries for the two years, assuming no technological "leap-frogging" in fibre optics (Takeuchi and others, 1986).

and beneficiation of iron ore has enabled the industry to lower its production costs for primary iron by reducing the ore input required per unit of primary iron output. Owing to improved furnace technology and stricter market requirements regarding use and quality of ore, the average ratio between the iron ore feed and the pig iron produced declined from 1.95 in 1955 to 1.88 in 1975 and to 1.81 in 1985. The rise in the average grade of iron ore worldwide (average percentage Fe content) was from 48% in 1955 to 59% in 1985 (UNCTAD, 1986 b). A series of coincidental developments, such as the emergence of "new mini-steel works" and the widespread adoption of electric-arc furnaces and continuous casting, have adversely affected iron ore demand in recent years through the minimization of inputs, while at the same time improving product range and quality.

With regard to other metals (for aluminium and copper, see UNIDO, 1989; Brown and McKern, 1987; ECLAC, 1989), though the available mining and processing technologies are in a process of continuous evolution, current developments are in most cases modifications of established techniques rather than entirely new processes. In view of this, the main constraints on the adoption of new technologies, at least in the primary stage of metal processing may be due not so much to their complexity and unavailability as to the large capital outlays which they entail.

b) *Agricultural products*

In agriculture the most remarkable changes centered around the "Green Revolution". This was manly concentrated in some developing countries of South and South-east Asia and Latin America and was based on the development, spread and adoption of modern high-yielding varieties, particularly of rice, wheat and maize, combined with increased use of inorganic fertilizers and irrigation. Various studies (a summary is provided in IDB, 1986) on Latin American agriculture support the view that during the last two decades the use of non-traditional inputs and technological change have played a much more important role than other factors such as acreage and manpower increases.

Now the Green Revolution seems to have run its course, and the yield-enhancing potential of mechanical and chemical inputs may be largely exhausted. Fears of inability to sustain a high growth rate in agriculture and of continued population growth, coupled with falling productivity have shifted attention increasingly to support for agricultural research on biotechnology, in the hope of an upsurge in productivity in both developed and developing countries.

Even though the routine cultivation of biotechnologically transformed plants is not expected before the mid-1990s, now is the time to evaluate its possible socioeconomic impacts, in order to implement appropriate measures before structural rigidities are firmly established. The new biorevolution must be harnessed and properly directed because it harbours not only certain unfavourable possibilities such as the displacement of the labour force and a more "closed" scientific circuit,[5] [6] but also positive potential for the poor of the Third World. This includes reduced dependence on agrochemical inputs, with substantial cost reductions, general gains in productivity and a wider variety of food products more in keeping with local tastes and

[5]As pointed out by some (Buttel and others, 1985; Ahmed 1988), a feature of the Biorevolution, which differentiates it sharply from the Green Revolution, is its predominantly private character. Major actors in biotechnology are transnational corporations which have managed to combine their in-house research capabilities, equity interests in genetic engineering venture firms, seed company ownership and access to university research via funding arrangements. The Green Revolution was, on the other hand, conceived and implemented within an institutional structure consisting mainly of public and quasi-public organizations, where the governments of developing countries and their national genetic programmes participated as clients.

[6]According to UNIDO, there exists a wide North-South gap in biotechnological research capacity. Recent surveys of companies involved in biotechnology show that only 20 out of a world total of 1 036 companies are in the Third World. A characteristic trend in recent years has been the acquisition of a large number of seed companies by transnational firms, particularly pharmaceutical and petrochemical companies. Because biotechnology involves the ability to link new varieties of seed to the use of specific fertilizers and pesticides, their supply of such seeds is claimed to enable the transnationals to expand a market for other agricultural inputs. A lop-sided research capacity is also reflected in Ahmed's assertion (1988) that there has been an outflow of genetic resources from the "gene-rich" South to the "gene-poor" North. It is estimated that 90% of all germplasm (total genetic variety available to a species) came from the Third World, because the temperate zones have lost almost all of their phytogenetic resources under the weight of the glaciers. Some 40% of that germplasm ended up in the gene banks of Europe and North America, while another 40% was stored by international agricultural research centres (IARCs). Only 15% was stored directly in the gene banks of developing countries.

conditions and a shorter time-lag in the adoption of biotechnology by small farmers than in the case of the Green Revolution.

2. *Structural changes influencing commodity consumption patterns*

a) *Sectoral changes*

For a broad range of raw materials exported by developing countries the growth of demand in the DMECs in recent years has been either stagnant or falling. In the 1960s, for instance, when GDP of the DMECs grew at 4.3% annually, consumption of many commodities, in particular minerals and metals, increased faster than GDP. In the following decade, in contrast, while the average economic growth rate of these countries dropped to about one-half the 1960s level, the consumption growth rate fell even more sharply. During the 1970s many commodities even recorded negative growth rates. The decline in commodity demand seems to have intensified in the 1980s, after the record rises for petroleum and most metals which resulted in the more rapid development and adaptation of materials-saving technologies and materials substitution.

In addition to the increased services-sector orientation of industrial economies which is believed to be at least partially responsible for the declining trend in demand,[7] the change in GDP patterns has been accompanied by marked changes within the manufacturing sector. An examination of the growth of domestic demand in volume terms by industries in selected DMECs for the period 1972-1982, as shown in table 1, sheds light on this aspect. Strong-demand industries include electrical equipment, electronics, information technology, automated office equipment, precision instruments, chemicals and pharmaceuticals. Demand for this group of products grew on average by 6.7% during the period. In contrast, moderate-demand industries, such as rubber, plastics and transport equipment, had a growth rate of 2.5%, and weak-demand industries, such as textiles and metal products, grew by 1.1%. This observation endorses the generally accepted view that, at least for the DMECs, growth has been poor in raw materials-intensive industries, and that a high level of performance has been found in high-technology industries with a low materials to value-added ratio.

Meanwhile, developing countries as a whole have faired substantially better in those industrial areas where the DMECs have seemingly been losing their comparative advantage. A comparison of the estimated percentage changes in value-added for the 28 branches of industry in the ISIC for 1976-1985 and 1985-1988, shows that the raw materials-intensive industries such as food, beverages, wearing apparel, wood and wood products, paper and paper products, rubber products, iron and steel, and non-ferrous metals, have shown relatively high growth rates for the Third World as a whole. In most cases these rates are significantly higher than the rates of countries in the North (UNIDO, 1987, p. 8). This phenomenon certainly reflects the changing structure of international trade and production, as well as the structural adjustment processes under way, especially in the DMECs.

The intrasectoral transformation in manufacturing has been facilitated by the steady progress made in information technologies and automation. In turn, the general tendency towards more automated and continuous, and more diversified, production processes increases the demand for most metals in the high-technology and special steels and alloys categories, owing to the high strength and low weight of their alloys and superalloys, and because they are used in high-speed, hot-work special machine tools or in special anti-corrosion applications.

A good example of the unimpressive recent demand for major traditional non-ferrous metals of general uses, compared to that of high-tech metals, is the United States domestic consumption pattern of 12 metals between 1972 and 1982. Only four of them exhibited positive con-

[7] As a reflection on the issue, Duncan (1988) points out that the share of services in GNP of the DMECs has been increasing for some time, in some of them reaching a high percentage before 1973. He explains that the relationship between industrial production and GNP is non-linear, and that an industrial economy grows rapidly —above a GNP growth rate of 2-2.5% — when its manufacturing sector is booming, and conversely, at low GDP growth rates services grow more quickly.

sumption growth: aluminium, the platinum-group metals (including iridium, palladium and platinum only), titanium and tungsten. Consumption of the remaining eight metals decreased at average annual rates varying from 1% (copper) to 5% (manganese, tin and zinc). Two of the four metals with growth in consumption derived it primarily from single markets: aluminium for metal cans, and platinum for catalytic converters. Only titanium and tungsten showed increased consumption in a variety of end-uses during this period (United States Bureau of Mines, 1986 a). The same data also confirm that total consumption and consumption per unit of output decreased for all metals except titanium, tungsten and the platinum-group metals.

In sum, the older non-ferrous metals have been affected to a greater extent and this category of metals has also been the most affected by substitutions in favour of light and specialty metals. Major substitutions among metals in favour of the older ones have been less frequent, as light and specialty metals usually find metal substitutes within their own category.

It is worth noting that Latin America's share in world reserves of new and other minerals such as chromite, cobalt, tantalum, vanadium, tungsten, zirconium and platinum metals is negligible and that only molybdenum (26%), columbium (78%) and silver (29%) held substantial shares in these reserves in 1985-1986 (Kürsten and others, 1988). In this sense, a strategy based on the exploitation of these non-traditional materials and the exercise of possible bargaining power due to concentration of supplies is not likely to be a viable development route for the region.

Table 1

GROWTH OF DOMESTIC DEMAND IN VOLUME TERMS BY INDUSTRIES IN SELECTED EEC COUNTRIES, THE UNITED STATES AND JAPAN, 1972-1982

(Percentages)

Industry	EEC[a]	United States	Japan	EEC,[a] United States and Japan
Strong-demand industries	5.2	4.8	13.5	6.7
Electrical equipment and electronics	3.7	5.5	5.1	7.7
Information technology, automated office equipment and precision instruments	8.9	5.7	6.8	7.0
Chemicals and pharmaceuticals	5.5	3.7	11.8	6.4
Moderate-demand industries	1.0	2.3	4.8	2.5
Rubber and plastics	3.2	5.0	1.2	3.5
Transport equipment	3.2	1.4	7.1	2.9
Paper pulp, packaging and printing	1.8	2.9	3.7	2.6
Food, drink and tobacco	2.0	1.7	3.8	2.2
Industrial machinery	0.2	3.2	3.6	2.0
Weak-demand industries	0.2	0.5	3.0	1.1
Miscellaneous products	1.3	1.8	1.4	1.5
Textiles, leather and clothing	0.2	1.5	2.7	1.2
Steel and metal ores	0.7	-0.7	3.7	1.3
Metal goods	-0.5	0.0	4.2	1.2
Construction materials, non-metallic minerals	0.9	0.3	1.8	1.0
Total manufactured products	1.9	2.3	6.4	3.1

Source: Eurostatistics and Commission departments.
Note: Based on United States dollars and at 1975 prices and exchange rates. The average annual growth rate is calculated on the basis of data smoothed over two years: average for 1981-1982 compared with average for 1972-1973.
[a]Belgium, Denmark, France, Germany, Federal Republic of, Italy, Netherlands and United Kingdom.
Cited in UNIDO (1987).

b) *Materials substitution*

The process of substitution in commodities embraces different types of phenomena, and its complexity is well documented in Tilton (1983). In some cases, although the competing materials perform essentially the same function (for example, the use of an aluminium beer can instead of a glass bottle), the selection is made on the basis of cost-effectiveness, efficiency or specific properties. In some substitution processes consumption is reduced (increased) by augmenting (reducing) non-material inputs such as labour, capital and energy. A clear example is the hand-soldering of household electrical goods, which requires less solder than more automated production using printed circuit boards. Producers of these products, however, have favoured the latter despite their higher materials intensity because they cut labour costs. In some substitutions what is changed is not the manufacturing process or the materials used in production but rather the use of the materials as a result of changes in the composition of the goods and services which they provide (for example, satellites vs. underground cables for long-distance communication).

And in other cases, substitution takes place when a technological innovation allows a product to be made with less material, perhaps adding new properties to it or improving the existing ones. This series of substitutions thus produces *materials-saving* effects, as mentioned earlier, and *quality alterations*. In the United States, thinwall casting, coupled with the downsizing of automobiles, has brought the weight of zinc diecastings used in American-manufactured cars down from 51 pounds in 1975 to 23 pounds per vehicle in 1983 (United States Bureau of Mines, 1986 a). The technological innovations in the zinc diecasting industry which made thinwall casting possible enabled zinc to gain an increasing share of the metal-casting market, but at the same time it brought about a much more efficient use of the metal with the result that less zinc is used in the process.

The behaviour of commodity markets tends to raise doubts about the assumption of conventional thinking that the functional relationship between price and demand is automatically reversible. In these markets, if a material loses a particular market, even temporarily, that market might be gone forever. It is quite possible that an industry will not recapture a market lost when it raises prices even if it subsequently lowers them to the previous level. The assessment of this reversibility becomes much more difficult for the medium or long term, during which the demand for plant, equipment and technology can change significantly. Even in the short run, when the cost of a particular material input contributes little to the production cost of many finished products, changes in materials prices alone do not usually generally produce major shifts in the output of final goods or services. It is more likely in the short run that relative price changes affect the degree of utilization of secondary markets (scrap) when this option exists.[8]

A material's demand curve is generally assumed to be continuous and smooth. However, given the nature of materials substitution, this assumption may not be very realistic, particularly for those materials which do not have diversified uses in their applications. Prices may rise within certain limits with little effect on demand, but once a particular threshold is crossed, demand may fall dramatically and make the use of a competitive substitute more attractive. Such sharp variations can occur in the short- and medium-term demand curves and they would be much more pronounced in the long run where technological innovation by its very nature, exerts its influence, in a highly unpredictable manner.

Therefore, changes in relative prices of competing materials alone may trigger little immediate shift in demand. It is more likely that the cost not only of materials but also of other factor inputs, and the specific properties of materials, performance and quality considerations, etc., are taken into account. In other words, the only relevant cost in materials substitution today is the so-called "total package cost".[9] Many new

[8]In the case of the United States, scrap accounted in 1986 for 25% and 45% of the primary production of aluminium and copper, respectively. Depending on production costs/prices of primary and secondary origins, producers change from one procurement source to the other or a mix of the two.

[9]As an example, the major advantage of aluminium over copper in the stringing of overhead power cables is the former's lighter weight, thus requiring fewer pylons per unit length than would be needed in the case of copper (Dresher, 1986). Therefore,

materials are priced higher than the traditional ones they displace. However, these new materials may be preferred because they ofer the opportunity to reduce manufacturing costs sufficiently to offset their higher prices (Fraser and others, 1987). These factors work in conjunction with other demand/supply factors such as domestic natural resource endowment, government industrial promotion programmes and cultural and traditional factors, as well as the country's per capita income level.

3. *Effects on comparative advantages and the international division of labour*

The preceding examination gives the impression that the demand prospects for commodities in which the countries of the Third World have been supposed to hold clear comparative advantages are uncertain and that this advantage seems to have been badly eroded by the current restructuring of commodity demand propelled by new technologies. Moreover, presumably highly labour-intensive sectors, such as textiles, clothing and assembly of electric goods, are slowly increasing their capital intensity, thanks to the incorporation of a higher technology content in production processes (ECLAC, 1988).

The consequences of the energy- and materials-saving efforts in the developed world are manifold. Since basic processing activities are energy-intensive and there is a limit to the capacity to recycle wastes, a natural sequence of events has been the relocation of the production of traditional industrial materials to developing regions. The chief aims are to obtain raw materials and energy at lower cost, save on the transport of raw materials, and take advantage of less rigorous environmental restrictions and the flexibility inherent in geographical proximity to raw material production sites. In spite of diminishing materials intensity, access to cheaper supplies gives companies a competitive edge as long as the require these inputs. It is also possible to create or strengthen comparative advantage: Latin America has been able substantially to transform its basket of export goods in the present decade by accelerated introduction of non-traditional products such as oilseeds and vegetable oils, fruits and fruit juices, shellfish, fish and fish products, wood and pulp, and poultry, the production of which is basically resource and labour intensive.

Another consequence might point in a different direction: style and quality specialization by developing countries in the production of certain commodity groups or components which are simpler and relatively less expensive and more labour intensive. Developing countries will probably continue to identify and exploit trade and production opportunities in such products. In the case of steel, for instance, a particular kind of division of labour has developed in recent decades with most developing countries producing ordinary steels and some industrialized or newly industrialized countries (NIEs) competing among themselves for the special steels market. While exports of footwear from developing countries will continue to be most successful in high-volume, low-cost markets, producers in developed and a few developing countries compete fully in the fashion market. The new textile machinery introduced in developed countries allows enterprises to be more flexible in production which is of higher quality with greater emphasis on styling and design, and to shift from the mass production of fabrics, common in developing countries, to shorter runs of high-quality fabrics. The types of finer yarns and lightweight fabrics increasingly sought in the apparel trade are produced by highly automated textile plants.

It is worth noting the following observations by Duncan (1988): i) the Third World's share of world production/exports of raw materials has increased for almost all products and is projected to continue increasing in the future; and ii) the shift of production/exports to the Third World has been accompanied by an increase in the latter's share in processing. In other words, the

in this application the relative cost of the materials is of secondary importance to the economy realized in the installed system. A similar example is found in the beverage packaging industry: the cost of producing an aluminium two-piece beverage container is substantially higher than the cost of a tinplate counterpart, but aluminium cans are less than half of the weight of tinplate cans, putting the former in a much more favoured position with respect to transport costs. In addition, aluminium cans do not rust or alter the taste of beverages, as tinplate cans are alleged to do, and they are easier and cheaper to recycle (Delmer, 1983).

production/exports of these products have shifted and will continue to shift in favour of developing countries, partly offsetting the declining growth trend at the global level. The most likely outcome of the spread of new technologies seems to be therefore that production will continue to relocate to the South in the search for comparative advantage, and that there will be neither a massive return of manufacturing production to the North or a dramatic deterioration of the export prospects of Latin America as a whole.

II

The use-intensity hypothesis: its usefulness and persuasiveness for the Third World

1. *The use-intensity hypothesis: its concept and implications*

There has been a fair amount of literature on the so-called use-intensity concept. It is generally defined as consumption of the product in question per unit of economic activity at constant prices. Its purpose is to isolate the impact on demand of factors other than the size and growth of the national macroeconomy. It is usually expressed in tons (or kilos) per million constant dollars of GDP.

It postulates that use-intensity is closely correlated with the level of economic development, as measured for instance by per capita GDP, and that the intensity rises up to a certain threshold and then starts to fall as the economy matures. The reason for this inverted U-shaped relationship is that after the materials-intensive stages, during infrastructure building and the development of manufacturing and metalworking, markets for industrial products reach a certain degree of saturation and technologically more sophisticated industries and services come to represent a more rapidly growing share of GDP than the traditional materials-intensive activities. In addition, over time technological progress makes it possible to produce a given set of products with ever-decreasing inputs of materials. This effect might permit late-comers to development to leapfrog over the materials-intensive stages of the pioneers and adopt the most up-to-date materials-saving technologies.

In short, the hypothesis suggests that: i) use-intensity *at a given level of economic development* will be lower in countries which are late-comers; and ii) use-intensity *at a given point in time* will be higher for middle-income countries than for low-income ones, whose intensity will rise over time up to a certain threshold. This means, on the one hand, that even though many developing countries may continue to increase their share in the world product or in movements of capital and consumer durables, their future materials demand and use-intensity will not necessarily reach the levels achieved in the past by the DMECs at comparable income levels. But, on the other, it also means that developing regions, with a substantially lower level of intensity or consumption per capita, should be regarded as untapped markets for many raw materials and semi-processed products for some time to come, pointing to the importance of domestic, intraregional and interregional market expansion in the Third World.

The examination of use-intensity in the DMECs gives certain substance to the often-raised concern that reduced demand is due to the changes in the composition of GDP and in the material composition of products. The use-intensity in these countries for petroleum, steel, copper, tin and to a lesser degree, lead and zinc (the case of aluminium is more ambiguous) has consistently declined during the last 15 years (for a detailed analysis, see ECLAC, 1989). In steel, for instance, Japan, the country with the highest intensity among the DMECs, reduced its level from 114.5 tons/million (in 1980 dollars of GDP) in 1973 to 55.7 tons in 1984. France, a low-intensity country, also reduced it from 55.9

tons in 1962 to 22.1 tons in 1984, without ever reaching a level comparable to the other DMECs. The most striking reduction has been in the case of tin whose use-intensity in recent years in the DMECs has been approximately one-third of the levels of the 1960s. Tin consumption in the United States, for example, dropped from a high of 59 100 tons in 1973 to 38 000 tons in 1986.

In spite of the spottiness of consumption data, it is possible to construct a similar intensity series for developing countries as a whole (Murray, 1988) and for Latin America in particular (ECLAC, 1989). This series seems to suggest that the countries of the Third World find themselves at a stage of increasing intensity —a process temporarily interrupted by the fall in investment caused mainly by the debt crisis.

It is equally important to recognize that the levels of per capita consumption of many commodities in Latin America are extremely low in relation to the leaders under this heading (see ECLAC, 1989). The world's highest per capita consumption in 1985 of 607 kg in Japan, 505 in the Federal Republic of Germany, and 440 in the United States stands in stark contrast to the region's top consumers: Mexico 96 kg, Brazil 88 kg, Argentina 72 kg, and Chile 47 kg. Per capita consumption in developing countries generally stands at 10-20 kg rather than in the 100-200 kg range of the Asian NIEs, such as Taiwan, Province of China, and the Republic of Korea. This huge gap in consumption, which is exhibited in other metals (see table 2), seems to suggest that there persists an extremely high potential for expanding production in developing countries. The rapid adjustment of industrial structure in the DMECs should further encourage this process.[10]

During the past quarter of a century the developing countries (including China) increased their share of non-CMEA GDP from 19% in 1960 to 24% in 1988. This modest change has brought with it a major increase in the developing countries' share of world metals demand. In 1985, for instance, their share of world metals consumption was 12.6% for primary aluminium, 12.3% for primary refined copper, 14.2% for lead, and 13.4% for primary tin (UNCTAD, 1987 c). These figures, which are not even adjusted for the metals contained in the net flow of semimanufactures and manufactures, clearly suggest that the developing countries do play an important role in determining the level of world metals demand (Murray, 1988). And these percentages should have been higher if the fall in investment as a proportion of GDP which took place after 1982 in the Third World had been taken into account. Therefore, the combination of rising use-intensity and rising industrial production could be a potential force in sustaining world demand for metals.

Examination of these industrial metals points to the conclusion that most developing countries find themselves at a development stage, where the unit input of materials and energy needed to produce an additional unit of GDP is likely to expand for some years to come. Any reductions in per capita materials requirements thanks to miniaturization, saving and substitution might be offset by increasing requirements for materials, mostly traditional, owing to rapid population increase, the need for infrastructure works, materialism and consumerism.[11]

The concept of use-intensity cannot properly be applied to agricultural products, owing to their low income-elasticity. It appears more useful to analyse instead their consumption growth pattern, especially for food and beverages. The effects of changes in income composition by product would be smaller in these cases.

Accordingly, table 3 shows the trend in annual growth rates of consumption of certain farm products in three different periods (1963-

[10] For instance, in Japan, the five largest steel mills have launched a programme to reduce by 1990 their combined capacity from 150 million to 90 million tons and to cut the work force by at least 25%. In this Asian country, primary aluminium production dropped from 1.2 million tons in 1977 to 0.23 million tons in 1985, while new projects tapped this metal in Brazil, Venezuela, India and Indonesia.

[11] The more dynamic elasticity of traditional metals against new substitutes is supported by Duncan (1988) who thinks that the decline of metals in the DMECs in the 1974-1985 period was largely cyclical rather than a reflection of a new downward trend in the rate of change in metal-saving technology or a change in output mix. The decline resulted mainly from the low rate of economic growth and the impact of high energy prices. In this view, recently resurgent capital investment in the DMECs and depressed energy prices, which are likelyto remain to some time, might reverse some of this dampening effect on materials demand.

Table 2

PER CAPITA CONSUMPTION OF METALS IN SELECTED COUNTRIES, 1985

Countries	Per capita (GDP) US$	Per capita consumption (kg)					
		Aluminium	Copper	Lead	Zinc	Tin	Crude steel
Austria	9 120	16.8	1.9	8.1	4.2	0.066	297.1
Belgium/Luxembourg	8 280	26.0	30.1	6.4	16.4	0.087	249.7
Denmark	11 200	4.3	0.3	2.6	2.4	0.020	353.5
Finland	10 890	3.4	14.7	4.9	5.3	0.020	360.8
France	9 540	10.6	7.2	3.8	4.5	0.125	267.3
Germany, Federal Republic of	10 940	19.0	12.4	5.7	6.7	0.272	504.7
Greece	3 550	8.9	3.9	2.3	1.5	0.040	156.9
Italy	6 520	8.2	6.3	4.0	3.8	0.088	381.7
Netherlands	9 290	6.1	1.2	3.1	3.5	0.352	290.4
Norway	14 370	30.8	3.1	3.3	5.0	0.095	340.2
Portugal	1 970	3.1	1.5	2.5	0.8	0.069	109.9
Spain	4 290	5.1	3.0	2.7	2.5	0.088	175.2
Sweden	11 890	11.1	13.1	3.2	3.8	0.048	392.0
Switzerland	16 370	22.0	1.4	1.6	4.0	0.123	350.8
Turkey	1 080	2.3	1.5	0.4	1.0	0.018	98.6
United Kingdom	8 460	6.2	6.1	4.9	3.4	0.166	257.2
Yugoslavia	2 070	9.1	6.4	5.1	4.6	0.061	220.0
India	270	0.4	0.1	0.1	0.2	0.003	18.1
Japan	11 300	15.1	10.2	3.3	6.5	0.262	607.4
Republic of Korea	2 150	3.5	5.0	2.0	2.9	0.063	243.2
Taiwan, Province of China	3 690	7.7	4.8	2.1	2.6	0.063	238.2
South Africa	2 010	2.4	2.1	1.5	2.6	0.059	165.0
Canada	13 680	13.5	8.8	4.6	6.2	0.150	524.3
United States of America	16 690	18.1	9.0	4.7	4.0	0.155	439.8
Argentina	2 130	2.7	1.3	0.9	0.8	0.026	71.8
Brazil	1 640	2.6	1.4	0.5	1.1	0.032	88.1
Chile	1 430	-	2.1	-	0.5	-	47.4
Mexico	2 080	1.0	1.5	1.1	1.3	0.013	95.8
Australia	10 830	17.9	7.8	3.7	5.2	0.171	363.3
New Zealand	7 010	10.5	0.6	3.0	7.5	0.030	223.9

Source: Federal Institute of Geosciences and Natural Resources, Hannover, Federal Republic of Germany. Cited in Rohatgi (1988).

1972, 1973-1984, 1980-1984), both in developed and in developing countries. In the food and beverages item, though the majority of its components registered a slowdown in their worldwide consumption between 1963-1972 and 1973-1984, some have achieved an increase in developing regions. In the cases of sugar, tea and palm oil, consumption growth in developing countries more than offset the decline in consumption in the DMECs. For the develoed world as a whole, only cocoa showed an upward trend between 1963-1972 and 1973-1984, for food consumption in these countries has been severely curbed. It is worth noting that even in the developed world some commodities —such as bovine meat, wheat, rice, coffee, cocoa, groundnuts, etc.— recorded an improvement in 1980-1984.

Among agricultural raw materials two products, unmanufactured tobacco and jute products managed to improve their consumption rates worldwide. Both of them, assumed to have been battered either by health campaigns or by competition from synthetic materials, also recorded an increasing rate in developing countries. In 1980-1984 the DMECs improved their consumption rate for raw cotton, rubber, sisal, wool, veneer sheets and plywood in comparison with 1973-1984. It should be stressed that this took place when the macroeconomic indicators of the DMECs had worsened substantially.

This analysis points to diversified consumption patterns among agricultural and metal products in different periods and regions. In addition to the level of economic development, other factors such as changes in consumer preferences, the level of supply and demand influenced by protectionism, and the pace of structural and technological change are having a strong effect on consumption patterns.

2. *Limitations of the concept, its applicability and factors responsible for varied consumption patterns among countries*

The concept of use-intensity is a useful instrument for predicting future consumption patterns of developed and developing countries. However, it is important to bear in mind several restrictions inherent in the concept itself.

Firstly, data on consumption at the country level reflect the measurement of consumption in manufacturing activities rather than "final' con-

Table 3

TREND ANNUAL GROWTH RATES OF CONSUMPTION OF INDIVIDUAL AGRICULTURAL COMMODITIES

(Percentages)

	World			Developed countries			Developing countries		
	1963 to 1972	1980 to 1984	1973 to 1984	1963 to 1972	1980 to 1984	1973 to 1984	1963 to 1972	1980 to 1984	1973 to 1984
Food and beverages									
Bovine meat	3.3	1.3	0.9	3.2	1.0	...	2.4	1.5	2.6
Wheat	4.0	2.7	2.4	2.7	5.1	2.5	4.5	4.3	4.1
Rice	3.1	2.9	2.7	-1.8	5.6	-1.2	2.9	2.6	3.0
Maize	4.2	-1.0	2.5	4.6	-2.5	1.4	3.5	0.9	3.9
Bananas	2.9	0.5	2.5	4.8	0.1	0.5	2.2	0.4	2.8
Sugar	1.7	2.7	2.7	2.7	-1.6	-1.4	6.5	4.1	4.7
Coffee	2.5	1.7	1.1	1.5	1.5	0.9	2.5	0.4	-0.1
Cocoa	2.3	3.4	0.9	1.3	4.5	1.8	18.9	-0.9	2.8
Tea	2.4	3.4	3.5	0.7	-0.5	-0.7	3.7	4.2	4.5
Soyabeans	7.7	0.3	5.1	6.8	-1.1	2.8	16.2	4.9	13.1
Groundnuts	1.1	2.7	0.1	-0.4	4.5	-2.4	1.5	2.5	0.6
Copra	2.1	-4.1	0.4	-2.2	-11.7	-13.8	3.9	-3.6	2.5
Palm oil	6.8	6.2	9.3	8.3	-0.5	-1.5	5.9	7.3	13.1
Agricultural raw materials									
Tobacco unmanufactured	0.3	2.3	2.0	-0.6	-1.9	-0.4	1.0	1.3	1.8
Cotton raw	2.4	1.6	1.5	-1.2	0.9	-1.0	4.0	2.5	1.9
Rubber	4.0	3.1	1.5	3.6	2.2	0.2	16.9	5.4	5.4
Sisal	-0.2	-5.3	-5.0	-2.6	-3.3	-10.3	5.2	-7.6	-3.0
Jute products	-0.8	-2.6	1.1	-2.7	-5.9	-5.7	0.1	-3.9	3.8
Wool	1.1	1.9	0.7	-0.6	0.6	-1.5	3.8	4.2	2.8
Sawlogs non-conifer	3.5	-1.8	0.3	2.2	-5.1	-2.5	8.0	1.7	4.0
Sawwood non-conifer	2.9	-1.3	0.8	2.6	-4.3	-2.3	6.0	1.0	5.6
Veneer sheets	9.2	-2.3	1.4	6.9	2.2	-0.1	13.0	-8.9	6.5
Plywood	7.5	2.4	0.3	7.7	1.7	-0.9	11.2	6.1	9.9

Source: UNSO statistics; UNCTAD, *Commodity Yearbook* 1986; International Commodity Organization and FAO data. Taken from UNCTAD (1987a).

sumption. The handling of imports and exports becomes problematic when they occur not only in the primary stages but also further along in the production process, since there is a high probability that many imported/exported products will contain raw materials. Copper estimates, for instance, take no account of imports/exports of semimanufactures or, more importantly, of manufactured goods containing copper, as in automobiles. While it is usually impossible to quantify the trade in goods containing copper, the international volume is substantial. The degree of underestimation of the processing of primary non-ferrous metals in the United States according to one study (United States Bureau of Mines, 1986a), can be considerable: the metals contained in imported intermediate manufactured goods are believed to have constituted 21% of imports in 1978, 21.5% in 1979 and 25.2% in 1980.

The applicability of the hypothesis is also somewhat reduced by the fact that technological progress which influences demand takes place in a discontinuous and irregular manner, and that the consumption pattern of materials have been strongly affected by big demand spurts as new markets open up for individual products. Well-known cases are the introduction of the Bessemer process late in the last century which made possible the large-scale production of steel, and the emergence of the electrical industry which created a new huge market for copper. Problems arise when a similar level of per capita GDP at constant prices is achieved between countries so many years apart for during the gap it is highly possible for a series of demand augmenting/reducing technologies to emerge. Extreme examples are the United States and Brazil, which attained a level of per capita GDP in constant 1980 dollars of US$1 500 at points in time roughly 100 years apart, and the United States and Mexico of US$2 580 roughly 75 years apart. The study by Radetzki (1987) reveals that the use-intensity hypothesis —a lower intensity at the same level of income for a late-comer— is vindicated only in the case of lead in a United States-Brazil comparison, and for the United States and Mexico the hypothesis holds for copper, lead and zinc, but not for aluminium, nickel and steel.

As the Radetzki analysis asserts, there are additional factors which distort the predictions of the hypothesis. His study of India points first to the role of government policies that affect the consumption levels of materials. A high use-intensity in three metal-intensive sectors (i.e., manufacturing, railways and electricity, gas and water) reflected India's option for heavy industry and infrastructure in its 1955-1965 development plans. Secondly, regardless of the supply of natural resources, a foreign-exchange shortage might encourage the government to pursue substitution of materials highly dependent on imports, with the aim of achieving greater self-sufficiency. For a long time, India's domestic output has met a very high proportion of its aluminium and steel needs, while a half or more of the consumption requirements for copper, lead and zinc have to be imported. Therefore, the government's encouragement of the consumption of the former and discouragement of the latter resulted in a consumption pattern quite different from what was expected.[12] Government promotion of some selected products, as in India, would lead to changes in relative prices, with import duties commonly used for this purpose. Supply shortages due to production rigidities or inefficient import planning and, last but not least, cultural factors also affect materials demand in patterns appreciably different from those postulated by the hypothesis.

This suggests that it is possible to create a number of final demands leading to intensive use of available natural resources of national or regional importance. It is also possible to identify some end-uses (for example, the electrical and electronics sector for copper) which are expanding faster than industrial production both in the industrial world and in the developing countries. The fact that the intensity of some end-uses has shown major improvement, even for products whose overall consumption growth is negative, points to the differentiated performance of each product which is usually hidden by the overall trend. This, in turn, reconfirms the importance of systematic research and development as a means of finding new uses and products.

[12]The government decree to use only aluminium in electricity transmission and domestic wiring increased the use-intensity of aluminium and decreased that of copper from the late 1960s.

III

Some strategic area for improvement and co-operation

1. *Technological competitiveness of Latin America in international trade*

A fundamental condition for successful and sustained technological innovation that generates new or improved products, processes or services is that financial and human resources should be directed to that end. Though it is true that there is no one-to-one correspondence between the available volume of resources and the desired result, countries which make large investmens in R&D have generally secured much better market opportunities than those which do not. One estimate (UNCTAD, 1987 e) suggests that in 1983 the world's R&D expenditure exceeded US$265 billion, and that of this total the DMECs and the socialist countries of Eastern Europe accounted for US$192 billion and US$64 billion respectively, leaving about US$9 billion for the Third World. In terms of total R&D expenditure as a percentage of GNP, the figure for the DMECs as a whole in the first half of the 1980s was around 2.4% whereas for Latin America it was at 0.5% (UNESCO, 1987). This R&D indicator coupled with others such as the number of scientists and engineers engaged in R&D, professionals and technicians as a percentage of the economically active population, literacy rate and education standards, however, puts Latin America in a better position than Asia and Africa (Teitel, 1986; UNCTAD, 1987 e). Nonetheless, the absolute amount is important from the point of view of the potential capacity to innovate, and in this respect the region is entirely deficient: for instance, the volume of technological resources available for Brazil, Argentina and Mexico taken together at the beginning of the 1980s was similar to that of General Motors in the United States (ECLAC/UNIDO, 1985). The absolute and relative paucity of the region's R&D expenditure implies a need for selectivity.

It then follows that developed countries are and will be specializing increasingly in high-technology producion, which requires a high level of human capital and extensive R&D, and that it is in these high-technology industries that they are seeking to maintain or strengthen their international competitiveness in production and trade. Nevertheless, it should also be recognized that in recent years the high-technology exports of developing countries have become an integral part of international trade (UNCTAD, 1987 e).

To define and calculate the technology intensity or content of a product is a complicated task. Despite a number of inherent difficulties and ambiguities, it is still useful to examine, as UNCTAD (1987 e) has done, the region's basic competitive positions in international trade according to levels of technological sophistication. The criterion for the classification is the relative importance of R&D activities as measured by the ratio of R&D expenditure to production.[13] All products are assessed in terms of five SITC (Standardized International Trade Classification) digits. They are classified according to the above-mentioned R&D intensity into three main categories —high, medium and low technology.[14] It is important to point out that most products in the low group and some in the medium group are naturally resource-intensive and that most of them are products which undergo little processing and can thus be considered as commodities as generically defined.

[13] Obviously, there are certain limitations to a measure of this kind. A list of such products will change over time as new products are developed and as the production technologies of existing products become more widely disseminated and standardized. Moreover, this measure does not fully measure the technology content of the products manufactured by an industry, since industries may differ in the degree to which they rely on their own R&D efforts, as distinct from utilizing technology from other industries or imported from abroad.

[14] *High* R&D intensity industries are aerospace, office machines and computers, electronics and components, drugs, instruments and electrical machinery. *Medium* R&D intensity industries include automobiles, chemicals, other manufacturing industries, non-electrical machinery, rubber and plastics and non-ferrous metals. *Low* R&D intensity industries are stone, clay and glass, food and beverages, tobacco, shipbuilding, petroleum refineries, ferrous metals, processed metal products, paper and printing, wood, cork and furniture, and textiles, footwear and leather.

Table 4

MANUFACTURES IMPORTS OF DEVELOPED MARKET ECONOMIES BY R & D INTENSITY CATEGORY AND MAJOR REGION OF ORIGIN

Country or region of origin	Market share (percentages)				Value (millions of dollars)	Annual growth rate (percentages)		
	1970	1975	1980	1985	1965	1970-1975	1975-1980	1980-1985
A. High R & D intensity								
World	100.00	100.00	100.00	100.00	158 196	19.7	21.9	5.5
Developed market-economy countries	89.30	86.91	79.86	77.57	122 712	19.0	19.9	4.9
Socialist countries of Eastern Europe	.61	.97	1.18	.55	863	31.5	26.7	-9.5
Developing countries	2.89	6.92	9.82	13.20	20 887	42.5	30.8	12.0
Latin America	1.02	2.18	2.08	3.36	5 315	39.4	20.7	16.2
Africa	.12	.18	.62	.33	525	29.8	56.2	-7.0
Asia	1.49	4.29	6.90	9.31	14 721	47.8	34.0	12.1
Oceania	.00	.00	.01	.00	5		47.6	-6.5
B. Medium R & D intensity								
World	100.00	100.00	100.00	100.00	371 717	18.4	19.8	3.0
Developed market-economy countries	80.80	81.89	80.89	77.75	288 994	18.7	19.6	2.2
Socialist countries of Eastern Europe	1.22	1.54	1.44	1.10	4 083	24.1	18.3	-2.4
Developing countries	4.80	5.03	6.72	8.95	33 276	19.5	27.0	9.1
Latin America	1.43	1.42	1.57	2.14	7 970	18.2	22.3	9.7
Africa	.43	.26	.26	.27	1 015	7.3	19.4	4.1
Asia	2.46	2.81	4.42	6.16	22 886	21.6	31.2	10.1
Oceania	.30	.34	.23	.10	372	21.3	11.0	-13.0
C. Low R & D intensity								
World	100.00	100.00	100.00	100.00	380 955	19.2	17.0	.01
Developed market-economy countries	69.89	67.99	64.77	59.36	226 137	18.5	15.9	-1.8
Socialist countries of Eastern Europe	3.66	4.4	4.69	4.48	17 053	23.9	18.3	-1.0
Developing countries	15.80	18.83	21.21	25.13	95 751	23.5	19.8	3.3
Latin America	6.33	7.01	6.81	6.55	24 957	21.6	16.3	-0.9
Africa	1.76	1.68	2.07	2.33	8 887	18.2	22.0	2.3
Asia	6.80	9.24	11.48	15.31	58 316	26.7	22.2	5.8
Oceania	.18	.26	.17	.13	505	27.9	8.0	-5.3

Source: UNCTAD secretariat calculations based on United Nations Statistical Office trade data (Comtrade). For the methodology of classification into R & D intensity category see *UNCTAD Trade and Development Report 1987.*

Statistical data on the composition of the imports of manufactures of the DMECs by category of R&D intensity and major region of origin (see table 4) reveal the changing competitiveness of developing countries in these markets. The table suggests first that although they still account for a relatively small proportion of total manufactures trade, the products of high R&D intensity industries have tended to be among the relatively more rapidly growing exports for all groups of coutries. Also, industries with high and medium R&D intensity have been increasing their relative contribution to total exports, whereas that of the low R&D intensity group has been falling. Although the growth rate of these exports declined steadily over the period, the deceleration was less pronounced for the developing countries as a whole than for the rest of the world. In 1985 the DMECs accounted for more than three-quarters of the market share of imports of manufactures of the high- and medium-intensity industries. In sectors with low R&D intensity, these countries still maintained a market share close to 60%. What is noticeable, however, is the significant inroads made by developing countries.

Among the developing regions, the market shares of Latin America rose slightly throughout the 15-year period in both the high- and medium-intensity industries. It is important to note that the performance of Latin America, in comparison with Asia[15] during the same period, has been much less impressive in terms of absolute trade values and of growth, for *all* three R&D categories. This is a result, on the one hand, of the Asian countries' efforts to promote high-tech exports, especially of electronic components, telecommunications equipment, and non-electrical and electrical machinery, and on the other, of their serious efforts to improve their position in manufactures with low R&D intensity, mainly through the processing of raw materials.

In general, the use of new technologies does not seem up to now to have prevented developing countries —including both the leading NIEs and the others— from increasing the growth of their exports and generally enlarging their shares in total DMEC imports of a large range of manufactures. An outward-looking trade policy, as practiced in the majority of Asian countries and in parts of Latin America, offers dynamic potential benefits for exports expansion based primarily on natural resources and low labour costs. Admittedly, those developing countries with sufficient technological capacity to absorb these innovations will be in a position to maintain or even improve their export shares, while those countries lacking the necessary skills, know-how, institutional flexibility and a basic capital goods industry are more likely to fall behind. Enhanced export competitiveness requires greater diversification and integration of production structures, especially development of linkages with input-producing home industries and other input-supplying economic sectors.

2. *Processing*

The interest in local processing as an economic objective for developing countries arises from a variety of reasons. They include: i) increase in the product's value-added; ii) reduction in export earnings fluctuation; iii) promotion of economic "linkages" in the national economy; iv) control over marketing and pricing and the possibility of obtaining monopoly and resource profits; and v) the potential for enhancing information about the industry and the market.

Examination of Latin American trade in commodities reveals a typical structure in which the countries in the region export goods in a primary state and then import the same goods from outside the region once they have been processed. An ECLAC (1986 a) study, which reviews Latin American exports to and from the OECD countries of 20 major commodities at three different processing levels (i.e., primary, semi-processed and processed), accords with this conclusion. The study shows that although in 1984 the value of the region's exports of these commodities to OECD was six times higher than that of its imports, most of the commodities were exported with minimum processing. Meanwhile, the region imported these same products for further processing.[16] It should be stressed that the term "processed products" refers only to commodities and excludes the subsequent phases of advanced manufacturing and industrial processing.

Over the years the proportion of developing countries' commodity production which is locally processed has increased. Local processing

[15] Asia consists of South, South-East and East Asia and the Middle East. Latin America includes the countries of the Caribbean.

[16] In agricultural products, the processing-level shares of the region's exports to OECD were as follows: primary, 64%; semi-processed, 16%; and processed, 20%. The respective percentages for OECD commodity exports were 41%, 31% and 28%. A high proportion of semi-processed and processed products imported from OECD was noticed, but the regional imports of commodities was important as well. In the minerals and metals sector, the situation was more dramatic: only 22% of regional exports consisted of processed products, whereas 77% of the imports from OECD involved processed products.

and the relative importance of processed imports by the DMECs from developing countries grew fairly rapidly in the 1960s and 1970s, but in a majority of cases it has been slowing down ever since. Moreover, in recent times a significant portion of imports by developed countries of certain processed commodities, such as those based on iron ore, cotton and wood, have originated *not* from the developing countries producing the raw materials *but* from the ones importing and processing them, notably the NIEs of Asia. Some statistical estimates (UNCTAD, 1987 a and c) of the degree of processing among different developing regions tend to accord with the view that Latin America as a whole processes a smaller proportion of the same products exported to developed countries than does its Asian counterpart.

The great processing potential of the Latin American region can be easily illustrated by looking at its shares in world mineral reserves and world ores and metals production. Table 5 makes it clear that in spite of being more favourably endowed with mineral reserves and having a greater mine production than Asia in bauxite, copper, lead, zinc and iron ore, the region's share in these products at the refined metal stages are not significantly different or even lower. A most striking case is iron ore, where both reserves and mine production appreciably exceed those of Asia, but raw steel production is 75% below Asia's. This low rate of processing of traditional metals is partly due to the fact that the region's share in world consumption for each of the seven metals is substantially lower. Though not shown in the table, the region's participation in semimanufactures production from these metals is also negligible (see World Bureau of Metal Statistics).

The expansion of downstream activities in this sector means, therefore, strengthening of sectoral policies in favour of local processing and generating a series of final demands which involves intensive and rational use of abundant natural resources. The production of semimanufactures and finished products offers greater flexibility in scaling down plant sizes and many opportunities to increase horizontal integration at the national and regional levels (UNIDO, 1989). This process should favour the selective expansion of activities which will bring with them sustained technological progress, as well as the generation and adequate incorporation of the so-called high technologies in selected areas.

3. *Redirection of commodities trade*

One potential line of action with the *present* technological capabilities of Latin America is to redirect its trade inwards. Despite what the available studies indicate (ECLAC, 1986 b; Sanz Guerrero, 1986; INTAL, 1986) —that the region possesses a high potential for increasing its intraregional trade in commodities— this trade amounts to little in practice and it has greatly diminished during the 1980s. In 1983-1985, total intraregional trade in non-fuel commodities stood at 8%: during this period, the region directed more than 62% of its commodity exports to the DMECs, while roughly 20% and 10% were absorbed by the socialist countries and the other developing regions respectively. Asian markets alone took 6% of its commodity exports. Intra-Latin American trade in commodities is believed to be substantially lower than its trade in manufactured exports.

It is interesting to observe that the ratio of intraregional commodities trade is not only at a low level but is also of minor importance when compared with other developing regions. During the last two decades Asia managed to increase its intraregional trade in non-fuel commodities by a substantial margin: from 22.5% (1966-1970) to 27.9% (1975-1979) and to 34.0% (1983-1985). Asia has been able to increase this ratio in a consistent manner in each of the major categories of product: foodstuffs, agricultural raw materials, and minerals and ores. To a lesser degree the African region has managed to increase this ratio, also in each of the three categories (UNCTAD, 1987 c).

An ECLAC study (1986 b) which analyses the region's commodity trade structure by origin and destination at a more disaggregated level (five SITC digits), shows clearly the magnitude of the potential to displace extraregional sources in favour of internal sources. As far as foodstuffs and agricultural raw materials are concerned, the potential for redirecting trade is particularly rich for such products as maize, wheat, sugar, soybean and its by-products, and other oilseeds and oils. The most salient minerals and metals are

Table 5

LATIN AMERICA'S SHARES IN WORLD RESERVES OF MINERALS, AND IN ORES AND METALS PRODUCTION AND CONSUMPTION, BY REGION, 1985

(Percentages)

Commodity	World (thousands of tons)	Europe	North[a] America	Latin America	Africa	Asia	Australia/ Oceania	Central-economy countries	Western industrial countries	Developing countries
A. World reserves of minerals (1985-1986)										
Bauxite	21 034 000	5	0	28	33	9	21	4	26	70
Copper	337 000	1	22	33	18	5	4	17	26	57
Lead	86 500	12	35	6	6	3	17	21	67	12
Zinc	147 600	15	29	12	8	11	11	14	64	22
Tin	3 240	4	2	8	5	65	6	10	13	77
Iron	65 502 000	4	12	18	5	7	14	40	34	26
Nickel	44 400	7	17	5	7	13	27	24	34	42
B. World mine production										
Bauxite	88 019	8	1	21	18	4	35	13	44	43
Copper	8 436	5	22	23	16	6	5	23	32	45
Lead	3 548	12	20	14	6	4	14	29	50	21
Zinc	6 918	17	20	16	4	7	11	25	53	22
Tin	197	3	...	24	5	45	3	20	8	72
Iron	518 496	6	11	19	7	5	12	40	31	29
Nickel	789	4	23	7	7	10	19	30	42	28
C. World metal production (refined)										
Aluminium	15 430	24	31	8	3	7	7	20	64	16
Copper	9 714	17	20	14	9	13	2	25	49	26
Lead	5 616	29	23	7	3	9	4	25	62	13
Zinc	6 750	29	15	7	3	15	4	27	60	13
Tin	206	13	2	17	3	44	1	20	18	62
Raw steel	714 997	22	13	5	1	20	1	38	51	11
Nickel	767	14	19	6	5	15	10	31	53	16
D. World metal consumption (refined)										
Aluminium	16 253	25	29	5	1	17	2	21	67	12
Copper	9 613	29	22	5	1	18	1	24	65	11
Lead	5 421	30	22	5	2	13	1	27	61	12
Zinc	6 492	26	17	6	2	19	2	28	57	15
Tin	213	26	19	5	1	21	1	27	61	12
Raw steel (1983)	656 331	18	16	3	2	19	1	41	45	14
Nickel	787	28	20	2	1	21	1	27	67	6

Source: Kursten and others (1988).

[a] Includes the United States and Canada.

aluminium, iron and steel, and copper products. Petroleum and its by-products, with a high potential for regional self-sufficiency —regional exports to the rest of the world far exceed regional imports— have undoubtedly the highest potential. Using the trade figures of the mid-1980s, the study suggests that intraregional trade could be considerably expanded and that efforts to redirect trade in 40 products (five SITC digits) towards the region itself could increase regional trade in commodities by more than US$15 billion.

There are substantial obstacles to full exploitation of this potential. Tariffs are one of the major barriers and are usually applied indiscriminately, regardless of supply origin. The regional tariff preferences (PAR) system within the framework of ALADI is in many cases insignificant, and a large number of products is excluded from it. In addition, a series of para-tariff measures is applied, in most cases uniformly and without differentiation as to origin. A major non-tariff barrier is known to be transport costs, which clearly favour procurement from outside the region (INTAL,1986). Marketing services and financing, totally deficient in the region, are heavily dependent on the channels of TNCs or developed-country governments, which are hardly likely to increase regional trade.

Regional co-operation in this direction should be emphasized at times when, as is now the case, the region's commodity exports are facing growing protectionism in the markets of developed economies, whose demand for a number of commodities is becoming more saturated. The growth of regional trade should be encouraged not only in order to economize on the region's meagre external resources and promote regional food security, but also in order to exploit the differences in consumption levels between developed and developing regions. It should be stressed that the scope for regional trade should increase substantially once the countries of the region have achieved a higher volume of commodity processing.

4. *Marketing and promotion*

Medium- and long-term promotion of demand has to do with the industrial organization of the product. It is interesting to compare aluminium and copper in this respect, for their situation holds important lessons for other commodities. The high growth rate in aluminium consumption —over 8.5% a year in 1960-1979 compared with 3.5% to 4.0% for copper— can be attributed not only to the properties of aluminium itself and its comparatively recent introduction as an industrial material but also to the high degree of industrial integration prevailing in the bauxite/alumina/aluminium industry. The most outstanding features of this industry have been: a stable pricing system, at least up until recently; the orderly development of production capacity; a large volume of research aimed at and concentrated on expansion of use; and the ability of the major transnational producers to invest in manufacturing facilities to bring new products onto the markets. By contrast, the efforts to discover, develop and promote new uses for copper have not proven sufficient, rather, the industry has centered its efforts on expanding production (Kuczynski, 1982; Morales, 1987; Mardones and others, 1985-1986).

The gradual vertical "de-integration" of the copper industry since the Second World War has produced a situation in which copper passed increasingly through the final markets semimanufacturers, who are many in number and have no links, either formal or informal, with raw materials producers. These semimanufacturers, also producing items made of other metals, have no special interest in promoting copper over the others. Primary copper producers, on the other hand, do not have access to final consumption markets where demand is actually determined. The lack of market intelligence about the requirements of end-manufacturers has made it difficult for them to promote copper. The lack of an information feed-back system has to some degree prevented materials producers from progressively integrating themselves in more diversified product groups with greater processing. In this light, attempts at progressive integration made by the producers themselves or in joint ventures should receive a high priority.

Since copper has much higher price instability than aluminium, a factor which has adversely affected its use, any promotion strategy must involve the establishment of an appropriate pricing policy. This might result in renewed support for some price stabilization schemes either in the form of international agreements or other arrangements. If price fluctuation is reduced, the efforts to promote consumption, maintain competitiveness with other substitutes, or find new uses can be sustained. Progressive integration into more advanced manufacturing processes should also help to reduce price instability.

A fundamental strength of the aluminium industry in research and promotion is the large amount of funds which a company like ALCAN or ALCOA allocates to these objectives (major companies spend more than US$100 million annually) and the basic nature of these efforts. By contrast, some estimates suggest that in 1985 the copper industry as a whole spent about 0.1% of the total value of sales of refined copper on marketing and research. Taking into account the reiterated importance of R&D on new and traditional uses with sufficient financial backing, it might be beneficial to strengthen research capabilities through agreements and co-operation among producer governments and international research organizations.

In the case of agricultural raw materials, it is important to note that some natural products have maintained or regained their competitive edge in some end-uses owing mainly to their technical properties (for a summary on this topic, see ECLAC, 1989). As in cotton, product differentiation designed to change consumer preferences in favour of natural products by emphasizing their "natural" characteristics (their appearance and moisture absorbency, coupled with improvements in processing to make them harder-wearing), has played an important role in market promotion. The standardization of materials and use of appropriate brandnames, as in the case of "Woolmark" has enhanced uniformity in quality and secured better prices than synthetic blends. Leather, with the appeal of high-quality consumer goods, especially in the DMECs, has transformed itself from a utilitarian raw material into a fashion and prestige product. Natural rubber's share of the world elastomers market has declined only slightly, thanks to the gains achieved in the tire sectors of the DMECs, especially through the massive shift from cross-ply to radial tires and the increase in heavy-duty tire production.

On the other hand, for products which have no clear technical advantages over synthetics and must therefore compete mainly on the ground of price (as in the case of jute and sisal), priority should be given to production research. This is aimed at lowering costs and enabling production to be maintained at the price dictated by the synthetic competitor.

Marketing ability is closely associated with the role of trading agents in gathering/processing/disseminating market information (Kuwayama, 1988). Appropriate and timely decisions on production, marketing and investment require a correct understanding not only of the local conditions in trading partner countries but also of the international macroeconomic indicators (for example, movements of interest rates, currencies and prices of "financial" assets —all of which affect commodity prices). With the development of advanced technologies, particularly high-speed information processing, which has led to increasingly widespread "programme trading" and round-the-clock trading among commodity exchanges, commodity markets are now more than ever before an integral part of the overall financial operations of international investors. This feature implies in turn the need for developing countries to create a market intelligence infrastructure competent enough to assess the creditworthiness of clients and the desired prices and profit margins.

Furthermore, marketing, processing and increases in intraregional trade are intricately related, since the possibilities of pre-export processing depend on the ability to secure beforehand market outlets for the processed product. Prior assurance of market possibilities is often a requisite for raising the necessary investment funds. Levels of intraregional trade also depend on the capacity of regional bodies to take over the related services provided up to now mostly by TNCs. From this standpoint, the strengthening of the existing (national or regional) marketing bodies and/or the creation of new ones, with a much more consolidated information and financial base seems an urgent necessity.

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