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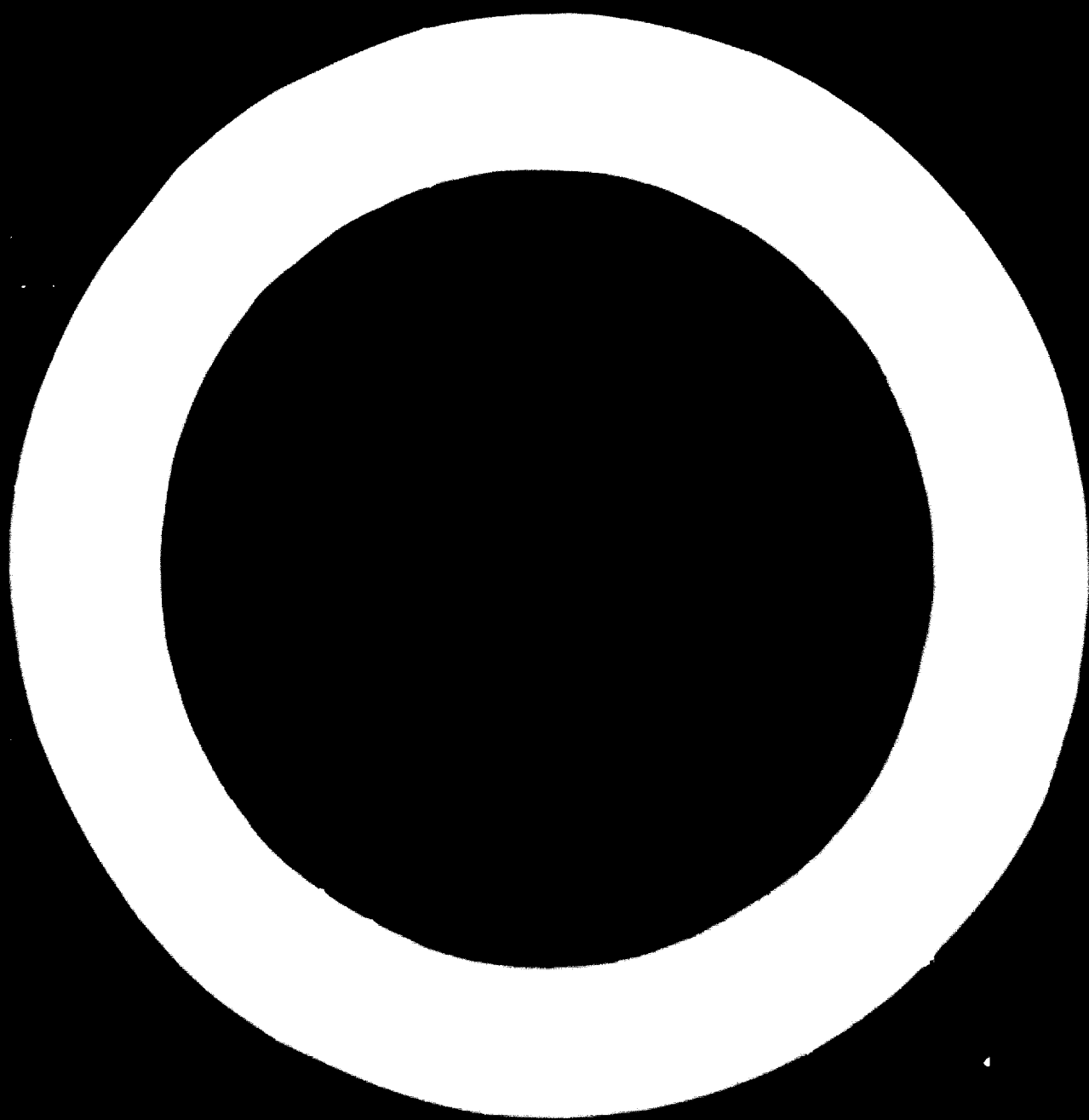
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DEVELOPMENT OF THE LATIN AMERICAN IRON AND STEEL INDUSTRY
IN THE PERIOD 1960 - 1971

Economic Commission for Latin America

id.73-3781

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SUMMARY

The document points out that, during the period 1960 - 1971, the Latin American total gross product grew at an average annual rate of 5.6 per cent, while the industrial product increased at a rate of 7 per cent, in other words at a rate equal to that of the increase in apparent consumption of rolled steel products.

This increase in the apparent consumption of rolled steel products was made possible by the very effective part played by local production of rolled goods, which grew at an average annual rate of 9.4 per cent. Imports of rolled goods, on the other hand, remained virtually stagnant for most of the period and increased slightly after 1968. Exports of rolled goods, which were only beginning in 1960, reached one million tonnes in 1971, of which approximately half was exported within the region and the other half to countries outside the region.

With regard to future demand of rolled steel products in Latin America, it must be borne in mind that industrial development is expected to intensify in coming years owing to the changes which are taking place in the industrial structures of the countries in the region, in which economic integration processes are playing an important part. For this reason, demand for rolled steel products would rise so sharply that estimates indicate a probable demand for rolled products, expressed in terms of ingot equivalents, of approximately 45 million tonnes by 1980. Since the only sources from which it will be possible to obtain the additional amounts of rolled products indicated by projections are imports and/or local production, local production will have to expand in step with the increase in demand for rolled products, since it appears unlikely that the situation with regard to availability of resources for importing will change radically in the next few years. This increase in production is feasible if the iron and steel industry expansion plans of Latin American governments and iron and steel enterprises are implemented, since if all plans were executed, steel production would be approximately 46 million tonnes in 1980.

With respect to the established iron and steel industry, the document points out that, between 1960 and 1971, it increased its production of pig iron by 171 per cent, that of steel by 190 per cent and that of rolled products by 166 per cent. In addition, some important facts are that, in this period, pellets began to be used in blast furnace charges; the manufacture of steel in LD converters spread rapidly and continuous casting began; in the production of rolled products, the rolling of flats increased considerably; and lastly, the starting up of new integrated plants improved the geographical distribution of steel production in the region.

Lastly, with regard to raw materials, the document points out that Latin America has abundant reserves of iron ore, which iron and steel plants obtain at a low price. As in other countries with more highly developed iron and steel industries, supply of coking coal presents difficulties, and it is suggested that a thorough study should be carried out to define once and for all the potential of the region for supplying this type of coal, in view of the enormous reserves which are to be found there and the high prices which it currently commands in the world market.

Chapter I

APPARENT CONSUMPTION OF ROLLED IRON PRODUCTS IN LATIN AMERICA

Before starting to analyse apparent consumption of rolled steel products in Latin America, the most characteristic features of the development of the Latin American economy in the years 1960-1971, which is the period covered by this document, should be described. During this period, the total gross product of Latin America increased by 82 per cent, which means that the average annual growth rate was 5.6 per cent. Although it is true that this figure indicates that the growth of the total Latin American product was similar to the average growth achieved in developing regions and slightly greater than the growth of the developed economies as a whole, the high rates of population growth of the Latin American countries in comparison with those of other regions^{1/} have a negative effect on the increase in per capita product. Thus, the Latin America per capita product, expressed in constant 1960 dollars, increased from \$391 to \$519 between 1960 and 1971, in other words at an average annual rate of 2.6 per cent.

If the analysis of the growth in the total gross product for the period concerned takes in the manufacturing sectors, it is seen that the growth in the industrial sector, which is without a doubt the one demanding the largest amounts of steel, exceeded the growth in total product, as can be seen from table 1, which shows rates of growth in the industrial sector for Latin America as a whole and for the countries in the region which have integrated iron and steel industries. The table shows that the sector grew at an average annual rate of 6.9 per cent between 1960 and 1970 and went on to be more active in 1971 and 1972, when it achieved a rate of 9 per cent. The latter figure was achieved thanks to the contribution of Brazil, whose rate of 14.1 per cent resulted from the expansion of its metalworking and engineering enterprises, and also the increased demand arising from public investment programmes.

^{1/} Approximately 3 per cent a year for Latin America as a whole. All the figures given in this paragraph were taken from ECLA, *Latin America and the International Development Strategy: First Regional Appraisal* (E/CN.12/947).

Table 1

AVERAGE ANNUAL INDUSTRIAL GROWTH RATE IN LATIN AMERICA
AND SOME SELECTED COUNTRIES
(Percentages)

	1960-1970	1971	1972*
Average for Latin America	6.9	7.4	9.0
Argentina	5.6	6.2	7.6
Brazil	7.0	11.3	14.1
Chile	5.3	12.9	2.8
Colombia	5.9	6.0	9.0
Mexico	9.1	4.2	7.6
Peru	7.4	8.8	7.0
Venezuela	6.6	5.1	6.9

Source: ECLA

* Estimates based on national accounts of the countries concerned.

With regard to internal changes in industrial production during the period in question, it was observed that the importance of traditional industries (or non-durable consumer goods industries) is tending to decline as the intermediate industries and - even more so - the metalworking and engineering industries, which comprise the producers of capital and durable consumer goods, in other words, the industries which require the most steel, enter the field.

Among the factors which have affected and are continuing to affect the acceleration of Latin American industrial development, is the fact that the export of manufactured goods has been made a prominent part of countries' industrial development policies. The endeavour to create a fresh impetus which would make it possible to expand the production capacity of industry and enter manufacturing branches in which the size of domestic markets was detrimental to the establishment of economic units has been the motive for the application of a number of instruments for the promotion of exportable domestic production. The results can already be seen from the fact that the share of new products in the total exports of Latin America increased from 5.7 per cent to 12.6 per cent between 1965 and 1971. Furthermore, the progress of regional and subregional integration programmes has resulted in the emergence of promising flows of trade in manufactured goods. Mention should also be made of the expansion and accommodation of domestic sources of industrial financing in the form of medium-term and long-term lines of credit for financing industrial production, and also the expansion of the institutional infrastructure to support industries.

Apparent total consumption and apparent consumption by country

In the eleven years between 1960 and 1971, the apparent consumption of rolled steel products, expressed in terms of ingot equivalent, increased from 9 to 18.9 million tonnes, in other words at an average annual rate of 7 per cent (see table 2). The expansion in the production of rolled products, which took place at an average annual rate of 9.4 per cent during the period under consideration, effectively contributed to the increase in apparent consumption. Table 2 shows that the share of production in consumption was 62 per cent in 1960, and had risen to 79 per cent by 1967. The same was not true of imports of rolled products, which virtually stagnated for several years, presumably as a result of limitations in the external sector which affect many countries in the region. These imports increased only in the final years of the period, mainly

Table 2

LATIN AMERICA: APPARENT CONSUMPTION OF ROLLED STEEL PRODUCTS
(Millions of tonnes of steel ingots)

	Production	Imports	Exports	Apparent Consumption	Percentage of Apparent Consumption covered by production
1960	5.6	3.7	0.2	9.0	62
1961	6.2	3.3	0.1	9.4	66
1962	6.6	3.1	0.1	9.6	69
1963	7.3	3.1	0.4	10.0	73
1964	8.8	3.5	0.4	11.9	74
1965	9.0	3.6	0.5	12.2	74
1966	9.8	3.5	0.5	12.8	77
1967	10.6	3.6	0.7	13.5	79
1968	12.1	3.5	0.8	14.8	82
1969	13.7	4.5	0.9	17.3	79
1970	14.3	4.8	1.1	18.0	79
1971	15.0	5.0	1.1	18.9	79

Source: MercaJo y Estructura de la Industria Siderúrgica, 1971 (Market and Structure of the Iron and Steel Industry, 1971) and La Siderúrgica de América Latina en 1971 (The Iron and Steel Industry in Latin America in 1971), both publications by the Latin American Iron and Steel Institute (ILAPI), Boletín Estadístico de Cuba (Statistical Bulletin of Cuba), 1970 and foreign trade yearbooks of Guyana, Haiti, Jamaica, Trinidad and Tobago and the Dominican Republic.

Table 3

LATIN AMERICA: APPARENT CONSUMPTION OF ROLLED STEEL PRODUCTS
(Thousands of tonnes of steel equivalent)

	1960	1965	1970	1971	per capita in 1971	Average annual growth rate of consumption 1960-1971 (per cent)
Argentina	1 941	2 723	3 069	2 996	123	4.1
Bolivia	23	51	96	64	17	12.5
Brazil	2 767	3 004	5 031	6 086	73	8.6
Central America ^{a/}	172	330	457	470	28	9.6
Chile	312	510	709	704	30	6.7
Colombia	392	444	764	791	37	6.6
Cuba	216	260	540 ^{b/}	540 ^{b/}	65	8.7
Dominican Republic	34	31	82 ^{b/}	82 ^{b/}	20	11.6
Ecuador	50	77	134	155	25	10.8
Guyana	-	20	48	90 ^{c/}	120	23.0
Haiti	-	-	15	15 ^{c/}	3	-
Jamaica	60	119	293	102	67	11.6
Mexico	1 92	2 807	3 030	3 759	73	6.3
Paraguay	12	19	20	26	11	7.3
Peru	136	379	333	340	25	5.9
Trinidad and Tobago	96	94	100	105	152	5.0
Uruguay	134	93	98	95	33	-
Venezuela	659	1 005	1 398	1 464	137	7.5
Total, 22 countries	3 960	12 161	10 010	10 940	66	7.0

Source: Statistical yearbooks for 1967 and 1970 and *Legislación en América Latina en 1971* (the Iron and Steel Industry in Latin America in 1971) both publications of IIAFA. In addition, *Boletín Estadístico de Cuba* (Statistical Bulletin of Cuba) for 1970 and and foreign trade yearbooks of Guyana, Haiti, Jamaica, Trinidad and Tobago and the Dominican Republic.

^{a/} Includes Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama..
^{b/} Owing to lack of more recent information, apparent consumption for 1960 has been given.
^{c/} Owing to the lack of more recent information, apparent consumption for 1970 has been given.
^{d/} Only eleven months in 1971.

due to the heavy pressure exerted on steel demand by the economic development programs of Brazil and Venezuela, which require products which are manufactured not at all or to a limited extent in the country. With regard to the exports of rolled products, table 2 shows the trend towards an increase owing to the fact that some countries, taking advantage of the favourable conditions of location for their iron and steel enterprises and their production costs, are looking upon export as a possibility for certain iron and steel products.

The development of apparent consumption of rolled steel products, by countries, is given in table 3, which also indicates the average annual growth rate of consumption and per capita consumption of rolled steel products. The table shows that Bolivia, Guyana, Jamaica, the Dominican Republic, Ecuador and Central American countries have higher rates of growth of consumption of rolled products. This is due to the fact that these are countries which have recently industrialized and are therefore in the stage of establishing enterprises for the import substitution of products with simple manufacturing technologies, many of which are steel consuming enterprises. It should be added that there has also been an intensification in building and communications activities in these countries. On the other hand, the countries whose industrialization has reached a more advanced stage had lower growth rates. This was the case for Brazil, Chile, Venezuela, Colombia and Mexico. An exception is Uruguay, whose average growth rate was negative.

Consideration of the table also shows that the average per capita steel consumption in the Latin American countries was 66 kg in 1971. This is still very low in comparison with the levels in other regions of the world, not only because there is a large unmet demand, primarily in those countries which depend entirely on imports of rolled steel products, but also because the population is increasing rapidly. None the less, the individual deviations from this average are very large, the range being from 3 kg for Haiti to 152 kg for Trinidad and Tobago.

The figures for per capita consumption of course do not include a breakdown for what is an important factor: the amount of steel contained in imports of industrial equipment and machinery, in which it is a very important component. This was not quantified because collection and analysis of such information is difficult owing to the manner in which countries classify their imports. None the less, the value of such

imports can serve as a point of reference, not only for giving some idea of steel content, but also for suggesting possibilities for import-substitution which might yet be undertaken in Latin America. According to the Bulletin of Statistics on World Trade in Engineering Products of the UN, in 1971 Latin American imports of industrial machinery and equipment (engineering products) amounted to \$6,650 million and accounted for 43 per cent of total Latin American imports in that year.

Returning to apparent consumption, table 4 was prepared to give percentage breakdowns by groups of products. In order to make it more representative, the average consumption of rolled products for 1970 and 1971 was used. Similarly, for purposes of comparison, the percentages for the average in 1960 and 1961 has been given.

Analysis of table 4 shows that plate and sheet consumption accounted for a larger percentage of the average for 1970-1971 than for that of 1960-1961. This confirms the general trend which is characteristic in countries which are industrializing, where consumption of flat rolled products, which is directly related to the development of manufacturing industries, grows more rapidly than that of non-flat rolled products because the latter are used mainly in traditional, already existing activities in these countries such as building and communications. A part is also played by the fact that rolled sections are being replaced by sections manufactured by means of welding of flat rolled products.

Imports of rolled steel products

The inadequate increases, and in some cases the declines, in the capacity of Latin American countries to import are the reason for which steel consumption has been falling while the decisive factors in its demand have been developing, thereby creating a backlog of unmet demand which constitutes a strong check on economic development.

Therefore, the development of local iron and steel industry has had considerable influence on steel consumption trends. If this were not the case, if the availability of iron and steel products depended only on import capacity, consumption of iron and steel products would not have reached their present levels in many Latin American countries. The volume of imports of rolled products over the period considered is shown in table 2, but the distribution of these imports for certain years is indicated in table 5, to which imports of semi-finished products for subsequent rolling have been added.

Table 4

LATIN AMERICA: DISTRIBUTION BY TYPE PRODUCTS OF CONSUMPTION OF ROLLED STEEL PRODUCTS -
 AVERAGES FOR 1970-1971 AND 1960-1961
 (Percentages)

Argentine	Bars and sections	Wire rod and wire	Plate and sheet	Tinplate	Total
Argentina	42.4	11.0	39.0	6.2	100
Bolivia	65.1	4.6	26.2	3.1	100
Brazil	37.4	11.2	45.1	6.3	100
Central America	30.2	13.3	46.5	6.3	100
Chile	33.0	10.3	49.1	6.5	100
Colombia	53.1	11.5	27.1	6.3	100
Cuba	34.0	3.3	53.0	9.7	100
Dominican Republic	51.0	11.0	25.0	3.0	100
Ecuador	56.0	13.7	24.0	5.5	100
Guyana	50.0	7.7	32.4	9.3	100
Haiti	63.6	3.4	12.0	21.0	100
Jamaica	38.1	28.6	24.7	8.6	100
Mexico	42.4	9.4	40.6	7.4	100
Paraguay	25.0	12.5	31.3	31.2	100
Peru	45.5	5.9	36.1	12.5	100
Trinidad and Tobago	76.4	5.4	18.2	-	100
Uruguay	47.4	12.8	33.3	6.5	100
Venezuela	51.4	8.3	32.1	8.2	100
Distribution by product, average for 1970-1971	41.2	10.4	41.5	7.4	100
Distribution by product, average for 1960-1961	48.9	10.9	32.8	7.4	100

Table 5 shows the increase in imports of flat rolled products, including tinplate. Manufacture of the latter in the region increased from 174,000 tonnes in 1960 to 485,000 tonnes in 1971. The increased consumption of tinplate is explained by the growth in the food-canning industry, which is developing rapidly in some countries.

With regard to imports of semi-finished products, it should be pointed out that during the initial years of the period, only steel billets and small amounts of bar iron were imported, while by the end of the period, approximately three-quarters of imports were accounted for by slabs for rolling flat products. The main importer of semi-finished products is Argentina, owing to the imbalance between the present steel production and rolling capacities of the San Nicolas plant. This situation will change next year when production is started in its new reduction and steel-making facilities, which will bring the plant into balance.

Imports of rolled steel products in 1970, by country, are given in table 6. The main importers of rolled products were Argentina, Brazil and Venezuela. This shows that in these countries, whose iron and steel industries have achieved a certain degree of development, domestic production of rolled products is inadequate to meet demand for certain products, while there are facilities for manufacturing other products in amounts which make possible their export.

Exports of rolled steel products

Until a few years ago, the Latin American countries were not able to export their products regularly, and when they did export them, it was usually as a result of fortuitous situations such as contractions in domestic markets for the products in question or temporary production surpluses owing to the starting up of new iron and steel facilities. In recent years, however, this situation changed as some producers realized that their location and own resources on the one hand, and changes in trade barriers, primarily among regional groups, on the other, made it possible for them to compete in the international market for several iron and steel products. This has made possible an increase in exports commensurate with production possibilities.

Table 7 shows the development of exports of rolled steel products in 1960-1970. In 1960, exports amounted to barely 150,000 tonnes of rolled products and 5,000 tonnes of semi-finished products. This figure represented 3.5 per cent of production in that year. Of the amount, 66 per cent was exported within the region and the remainder to

Table 5

LATIN AMERICA: EXPORTS OF ROLLED STEEL PRODUCTS 1960
17 MAIN CATEGORIES OF PRODUCTS
(Thousands of tonnes of rolled products)

	1960	1962	1968	1970
Bars and sections	755	462	476	565
Wire rods and wire	194	214	196	195
Plate and sheet	730	790	959	1,412
Tinplate	306	273	350	417
Seamless tubes	140	137	114	151
Tubes with seam	169	130	60	-
<u>Total</u>	2,308	2,016	2,155	2,740
Semi-finished products	661	431	708	1,522

Source: Statistical yearbooks, 1967 and 1970; La Siderurgia de América Latina en 1971 (The Iron and Steel Industry in Latin America in 1971). Both publications by ILAPA.

Table 6

LATIN AMERICA: IMPORTS OF ROLLED STEEL PRODUCTS IN 1970, 17 COUNTRIES
(Thousands of tonnes of rolled products)

	Bars and sections	Wire rod and wire	Plate and sheet	Finplate	Seamless tubes	Total rolled products	Semi-finished products
Argentina	75	6	278	120	9	488	1,132
Bolivia	45	3	18	2	-	68	
Brasil	151	47	260	56	37	551	41
Central America	16	41	160	28	-	245	86
Chile	43	3	38	-	6	89	56
Colombia	72	16	136	20	18	262	59
Ecuador	34	14	21	6	-	75	-
Mexico	57	13	49	48	13	180	138
Paraguay	5	-	6	4	-	15	-
Peru	26	7	90	31	19	173	-
Uruguay	10	11	27	5	-	53	3
Venezuela	32	35	329	97	49	541	6
Total	565	195	1,412	417	151	2,740	1,521
Percentage of total	20.6	7.1	51.6	15.2	5.5		

Source: *La Siderurgia de América Latina en 1971* (The Iron and Steel Industry in Latin America in 1971), IASA publication.

Table 7

LATIN AMERICA: EXPORTS OF ROLLED STEEL PRODUCTS
(Thousands of tonnes of rolled products)

	1960	1962	1968	1970
Bars and sections	85	2	166	200
Wire rod and wire	14	5	58	109
Plate and sheet	67	42	269	381
Tinplate	1	2	1	4
Tubes with seam	1	15	44	
Seamless tubes	2	3	69	77
Total rolled products	150	69	607	851
Semi-finished products	5	17	330	378

Source: Statistical yearbooks for 1967 and 1970; La Siderurgia de América Latina en 1971 (The Iron and Steel Industry in Latin America in 1971). Both publications by ILAFA.

Table 3

LATIN AMERICA: REPORTS OF ROLLED STEEL PRODUCTS BY THE MAIN COUNTRIES
(Thousands of tonnes of rolled products)

	1960		1970		Semi- finished products
	Bars, sections, wire rod and wire	Plate and sheet	Bars, sections, wire rod and wire	Plate and sheet	
Argentina	-	-	149	62	
Brazil	17	1	227	138	212
Chile	26	62	-	3	
Mexico	12	4	3	177	
Venezuela	-	-	7	-	166
<u>Total</u>	65	67	386	380	378

Source: Statistical yearbooks for 1967 and 1970. La Siderurgia de América Latina en 1971 (The Iron and Steel Industry in Latin America in 1971). Both publications by ILAM.

countries outside the region. Chile was the largest exporter of rolled products in 1960 (see table 8), but its exports declined almost to the point of disappearing entirely in subsequent years owing to the expansion of its domestic market and the delay in its iron and steel industry expansion programmes.

By 1970, exports had increased to 851,000 tonnes of rolled products and 378,000 tonnes of semi-finished products, and accounted for 11 per cent of total production of rolled products. In 1970, of total exports, 54 per cent went to countries in the region and the remainder to countries outside the region.

Projections of demand

Using figures taken from its studies of national markets for iron and steel products and other background material, the Latin American Iron and Steel Institute (ILAPA) prepared table 9, which presents projections of demand for rolled steel products for 1980, expressed in terms of steel equivalent.

The sum of the projections is impressive since it indicates that 17 Latin American countries will increase their steel consumption from 17.9 million tonnes in 1971 to 44.5 million tonnes in 1980. If this is so, the increase in apparent consumption of rolled steel products for all the 17 countries taken as a group would grow at an average annual rate of 10.6 per cent, or rather more than the 7 per cent shown in 1960-1971.

Since the amounts of rolled products appearing in the projections will come from increased imports and/or increased local production, local production will have to expand in step with the increase in demand for rolled products, since it appears unlikely that the situation with regard to availability of resources for importing will change radically in the next few years. This increase in production is feasible if the iron and steel industry expansion plans of Latin American governments and iron and steel enterprises are implemented.

If these expansions really do take place, annual steel production for rolling purposes could be as follows by 1980 in the main producing countries:

Argentina	10.0 million tonnes
Brazil	20.0 million tonnes
Chile	2.6 million tonnes
Colombia	1.3 million tonnes
Mexico	10.0 million tonnes
Peru	1.5 million tonnes
Venezuela	3.0 million tonnes
<u>Total</u>	<u>48.4 million tonnes</u>

Table 9

PROJECTIONS OF DEMAND FOR ROLLED STEEL PRODUCTS FOR 1980
IN 17 LATIN AMERICAN COUNTRIES

(Thousands of tonnes of steel equivalent)

	Rolled products, other than flats	Flat rolled products	Total	Per capita Consumption (Kg)
Argentina	3,669	3,632	7,301	259
Bolivia	104	45	149	25
Brazil	9,200	10,300	19,500	150
Central America	557	459	1,016	45
Chile	505	741	1,326	116
Colombia	502	537	1,119	36
Ecuador	269	112	381	45
Mexico	4,850	5,109	9,967	140
Paraguay	44	29	73	21
Peru	621	656	1,277	69
Uruguay	96	79	175	54
Venezuela	1,292	851	2,143	143
Total	21,077	22,630	44,507	129
Percentage of total	49.2	50.8		

Source: ILAPA. Mercado y Estructura de la Industria Siderurgica en América Latina
(Market and Structure of the Iron and Steel Industry in Latin America).
The data for Brazil have been corrected in accordance with information in
the IBS (Brazilian Iron and Steel Institute) review of January 1973.

CHAPTER II

THE LATIN AMERICAN IRON AND STEEL INDUSTRY

Latin American production of steel ingots increased from 4.8 million tonnes to 13.8 million tonnes between 1960 and 1971. In other words, steel production grew during the period under consideration at an average annual rate of 10.1 per cent. During the same period, production of pig iron underwent a parallel increase from 3.2 million tonnes to 8.6 million tonnes, the average annual increase thus being 9.4 per cent (see table 10). The present nucleus of the Latin American iron and steel industry consists of 23 integrated plants which in 1971 produced 81 per cent by weight of the steel billet production of the region. There are 57 semi-integrated plants which, using scrap, manufactured the remaining 19 per cent. Nearly all these plants use electric furnaces. In addition to the integrated and semi-integrated plants, there are many re-rolling mills which purchase billets from other enterprises. Their production fluctuates considerably because it depends on the supply of billets, which are imported for most re-rolling mills.

Latin American production of hot-rolled steel products in 1971 is shown in table 11. The total volume of rolled products was 11.2 million tonnes, the highest figure achieved to the present time in Latin American. The largest producer of rolled steel products was Brazil, which accounted for 40.6 per cent of the total, followed by Mexico with 27 per cent and Argentina in third place with 18.5 per cent. The other producing countries lag very far behind.

With regard to types of rolled products, the largest share, or 30.4 per cent of the total, was accounted for by sheets of less than 4.75 mm, followed by bars for reinforcing concrete, accounting for 21.2 per cent, and in third place light sections, making up 14.1 per cent of the total.

As has already been pointed out, re-rolling mills and some integrated plants which have excess installed rolling capacity import semi-finished products for subsequent re-rolling. In 1971, imports of semi-finished products for various plants in Latin America amounted to 1.7 million tonnes, which means that of the hot-rolled products manufactured in 1971, around one-tenth were produced using imported semi-finished products.

Table 10

**LATIN AMERICA: PRODUCTION OF PIG IRON^{a/}, SPONGE IRON,
STEEL IN INGOTS AND HOT-ROLLED PRODUCTS**

(Thousands of tonnes)

	Pig iron		Sponge iron		Steel		Hot-rolled products	
	1960	1971	1960	1971	1960	1971	1960	1971
Argentina	181	861			277	1,915	789	2,074
Brazil	1,838	4,686			2,260	5,997	1,653	4,541
Central America							9	43
Chile	266	458			450	653	285	506
Colombia	176	243			172	325	113	309
Ecuador								25
Mexico	659	1,663	115	672	1,474	3,821	1,242	3,024
Peru	39	143			60	179	38	106
Uruguay					10	15	36	18
Venezuela		515			47	924	51	536
Total	3,169	8,589	115	672	4,750	13,838	4,207	11,182

Source: ILAPA, Statistical yearbook for 1967 and La Siderurgia de América Latina en 1971 (the Iron and Steel Industry in Latin America in 1971).

a/ Includes the pig iron used for founding.

Table 11

LATIN AMERICA: PRODUCTION OF HOT-ROLLED STEEL PRODUCTS IN 1971^{a/}
(Thousands of tonnes of rolled products)

	Argen- tina	Brazil	Central America	Chile	Colombia	Ecuador	Mexico	Peru	Uru- guay	Vene- zuela	Total	% of total
Rails and rail joints	16	62	-	-	-	-	4	-	-	-	82	0.7
Heavy sections	60	81	-	-	-	-	132	-	-	40	323	2.9
Light sections	209	774	-	74	58	1	286	25	-	48	1,576	14.1
Bars for concrete	411	719	43	72	164	24	553	73	17	290	2,366	21.2
Wire rod for drawing	317	547	-	65	42	-	237	9	-	41	1,258	11.3
Strips	65	-	-	2	2	-	4 ^c	-	-	-	114	1.0
Plates, more than 4.75 mm	255	540	-	78	2	-	472	-	-	-	1,345	12.0
Sheets, less than 4.75 mm	461	1,667	-	214	31	-	1,025	-	-	-	3,398	30.4
Sheet for electrical uses	-	16	-	1	-	-	-	-	-	-	17	0.1
Seamless tubes	147	135	-	-	-	-	180	-	1	118	581	5.2
Other rolled products	34	-	-	-	-	-	89	-	-	-	123	1.1
Total	2,075	4,540	43	506	309	25	3,023	107	18	537	11,183	100.0
Percentage of production	18.5	40.6	0.4	4.5	2.8	0.2	27.0	1.0	0.2	4.8		

Source: ILAPA, La Siderurgia de América Latina en 1971 (The Iron and Steel Industry in Latin America in 1971).

a/ Provisional figures.

Lastly, important changes took place in the structure of the Latin American iron and steel industry between 1960 and 1971. Six integrated plants, including two in Argentina, two in Brazil and one each in Mexico and Venezuela, started up. In addition, there were substantial expansions in the production of existing plants in the context of more extensive expansion plans whose implementation is to be completed in the next few years. The new plants and expansions of existing plants have brought blast furnaces of modern design, LD steel works, continuous casting facilities and continuous rolling mills to the Latin American iron and steel industry.

In summary, during the period under consideration, production of pig iron and steel increased by 171 per cent and 190 per cent, respectively; pellets were introduced into blast furnace charges; the manufacture of steel in LD converters became more widespread; computers started to be used in plants; the proportion of rolled products accounted for by flats increased and, with the starting up of the new integrated plants, the geographical distribution of steel production in the region improved.

Production of pig iron and sponge iron

The figures in table 12 indicate that coke blast furnaces are continuing to grow increasingly predominant in the manufacture of pig iron. Charcoal blast furnaces follow them in importance, and are used only in areas which have abundant firewood resources. At present they are restricted to Brazil and northern Argentina.

Electric reduction furnaces were used to make 8 per cent of the total pig iron produced in 1971. More than three-quarter of the pig iron produced in this type of furnace came from the Venezuelan Orinoco plant.

According to the plans for expansion of iron and steel production being made by various Latin American countries, blast furnaces will predominate more than ever in future because the most important projects only provide for pig iron production in blast furnaces.

Lastly, returning to table 10, the manufacture of sponge iron increased when another iron and steel plant using the sponge iron process was set up in Mexico. A third plant of this type will soon be added in Brazil.

Steel production

Table 13 shows the distribution by process of steel manufacturing in 1960 and 1971. The Siemens Martin process continued to be the most widespread one, accounting for 53 per cent in 1971. The last starting up of a Siemens Martin furnace in a Latin American integrated plant dates back to April 1967, and no Latin American integrated plant is considering this type of furnace in its expansion plans, although overhauling of these furnaces to achieve maximum possible production from them is included in the plans.

As regards electric furnaces, their increasing flexibility and ability to be adapted to the most varied circumstances makes them preferable for plants operating on a small scale under Latin American conditions, and their use can therefore be expected to increase in future.

The use of oxygen has made traditional converters obsolescent. In Latin America, the use of oxygen converters will be standard for expanding steel mills because these converters require a smaller investment and smaller amounts of scrap, and minimize the effects of economies of scale.

Utilization of modern technologies

During the period under consideration, Latin American iron and steel enterprises were introducing the technologies used in iron and steel plants in the major steel producing countries.

Technological advances applicable to reduction shops, in particular those which decrease coke consumption, are in the course of time gaining in importance. One of the most favourable factors affecting production costs in the Latin American iron and steel industry is the abundance, high quality and low price of its iron ores. However, as a counterbalance to the raw material situation, the price of coking coal has the greatest negative implications for the production cost of pig iron. Enterprises therefore seek to make maximum use of their ores while at the same time reducing specific coke consumption to a minimum.

The facilities which Latin American iron and steel plants afford for the introduction of technological innovations strongly influences the size of the role these innovations play.

Table 12
 LATIN AMERICA: PRODUCTION OF PIG IRON^{a/}, BY PROCESS
 (Percentages)

	1960	1971
Electric reduction furnace	4	8
Charcoal blast furnace	32	25
Coke blast furnace	64	67

Source: Mercado y Estructura de la Industria Siderúrgica en América Latina (Market and Structure of the Iron and Steel Industry in Latin America) and La Siderurgia de América Latina en 1971 (The Iron and Steel Industry in Latin America in 1971), both publications by ILAFA.

a/ Includes pig iron for founding.

Table 13
 LATIN AMERICA: STEEL PRODUCTION, BY PROCESS
 (Percentages)

	1960	1971
Bessemer	1	1
Thomas	3	2
Oxygen converter	5	17
Electric furnace	26	27
Siemens Martin	65	53

Source: Mercado y Estructura de la Industria Siderúrgica en América Latina (Market and Structure of the Iron and Steel Industry in Latin America) and La Siderurgia de América Latina en 1971 (The Iron and Steel Industry in Latin America in 1971), both publications by ILAFA.

For example, in some cases, the use of oxygen in Siemens Martin furnaces required large investments because the space and equipment for handling materials going to the furnaces was not adequate in steelworks as originally designed to allow for the larger volume of materials required for the increased steel production achieved precisely through utilization of oxygen. It was therefore necessary to redesign the whole part of the shop intended for the preparation of furnace charges, thereby increasing the investment.

In addition, owing to the limited amount of investment resources available in the Latin American countries, these countries had to make a considerable effort to embark on integrated iron and steel production, and therefore, once the planned plant construction stage was completed, it was very difficult to make fresh investments in installations until a period of time which varied from enterprise to enterprise had elapsed. This was another one of the reasons for the delay of plants in introducing technological innovations of great importance for economic operation such as sintering, the use of oxygen in the air injected into the blast furnace, etc.

Similarly, the effort made by two iron and steel enterprises in Brazil and Mexico should be described. The enterprise in Brazil was the first one in the region to introduce important technological innovations - sometimes, as in the case of sintering and LD converters, when there was still no certainty of the industrial success of the process^{1/}. The Mexican plant was the first one to use a direct reduction process which, furthermore, was developed as a result of its own research.

Currently, technological advances such as the size preparation of the blast furnace charge and use of sinter are widespread. The use of pellets started only recently because their manufacture in the region also started recently, but prospects for their use are very considerable and will become more immediate when production by Argentina, Chile and Venezuela, which have plans along those lines, is added to that of Brazil and Peru, which are now producing pellets. Continuous casting is already being used in some plants to manufacture billets.

^{1/} Sintering was introduced in 1948 and LD converters in 1957.

As was pointed out above, it is sought to economize coke in blast furnace operation, and this is the reason for the interest shown by plants in innovations such as the injection of auxiliary fuels through the tuyeres and the blowing of air at higher pressures and temperatures.

In steelmaking, there is a general trend towards the use of oxygen. Increases in steel production planned in integrated plants provide exclusively for its use. Also, the reduction in investment, improved yield obtained and increased uniformity in chemical composition of products achieved with continuous casting have interested Latin America's iron and steel entrepreneurs in introducing this type of casting the next time they expand their operations.

Chapter III

RAW MATERIALS FOR THE LATIN AMERICAN IRON AND STEEL INDUSTRY

Iron ore

With the exception of Argentina, which supplies itself only partially with local iron ore, the other countries in the region which have integrated iron and steel industries are self-sufficient in iron ore.

Latin America has good resources of high-grade easily exploited iron ore. Most of the iron and steel plants in the region are supplied with strip-mined ores extracted at low cost. The exceptions at the present time appear to be the plants at Zapla in Argentina and Belencito in Colombia, both of which have partly underground mining, but which both work their own iron ore mines in close proximity to their iron and steel works - in Argentina, 12 kilometres from the blast furnaces and in Belencito, 30 kilometres from the blast furnaces.

In addition, the ore used by iron and steel plants in Brazil, Chile, Peru and Venezuela comes from large-scale mining operations planned to supply massive exports, so that in respect of the type and volume of mining the cost of ore extraction is very low.

At present, one Argentine plant is importing iron ore from Brazil, Chile and Peru, but this situation will change very soon, when it receives pellets from the Sierra Grande deposit located about 1,250 km south of Buenos Aires. It is planned to manufacture 2 million tonnes a year of pellets there.

It is probable that the iron ore deposit at Mutún in Bolivia, which is not yet being exploited, is one of the largest ones in the world. Bolivia has no iron and steel industry, but is carrying out studies on the large-scale exploitation of its iron ore for export and for use in an iron and steel plant intended to meet the demands of its own market and to export some rolled products to neighbouring countries.

Coking coal

The situation in the region with regard to coking coal is very different from that with regard to iron ore. Although it has been estimated that there are coal reserves of nearly 100,000 million tonnes in Latin America, little is in fact known about them,

not only as concerns the volume of the reserves themselves, but also as concerns the quality of the coal, its beneficiation and its coking properties. It is for this reason that the supply of coking coal or coke itself presents the main raw material supply problem of the Latin American iron and steel industry.

It is probable that the lack of interest and of thorough studies concerning the Latin American coal deposits can be traced back to the time when the countries which are today the most industrialized ones in the region began to industrialize. Finding that, at the time, petroleum was the preferred fuel, the new entrepreneurs concentrated their interest on it, neglecting coal.

The Latin American iron and steel enterprises, which must import coking coal or coke, are devoting special attention to ensuring their future supply in view of the shortage in the world market. The proportion of imported coal in the mixtures going to coking plants differs from country to country depending on the properties of local coals. For example, in Argentina, the mixture includes 85 per cent imported coal, while the proportions for Brazil and Chile are 60 per cent and 40 per cent respectively. Peru and Venezuela import coke directly. In future, however, if the supply of coking coal increases in the world market, the composition of mixtures may shift toward higher proportions of imported coals owing to the low quality and high price of domestic coals. The difficulties entailed by extraction and the low productivity of exploitation of the mines now supplying iron and steel plants in Argentina, Brazil and Chile are at the root of the high product prices.

Nonetheless, in view of the fact that large carboniferous formations of various types and characteristics are known to exist in the region and could be worked on a large-scale basis at low cost, it would appear advisable to carry out a thorough study of the feasibility of manufacturing blast furnace coke using Latin American coals alone. The study should be carried out jointly by the iron and steel enterprises consuming coke.

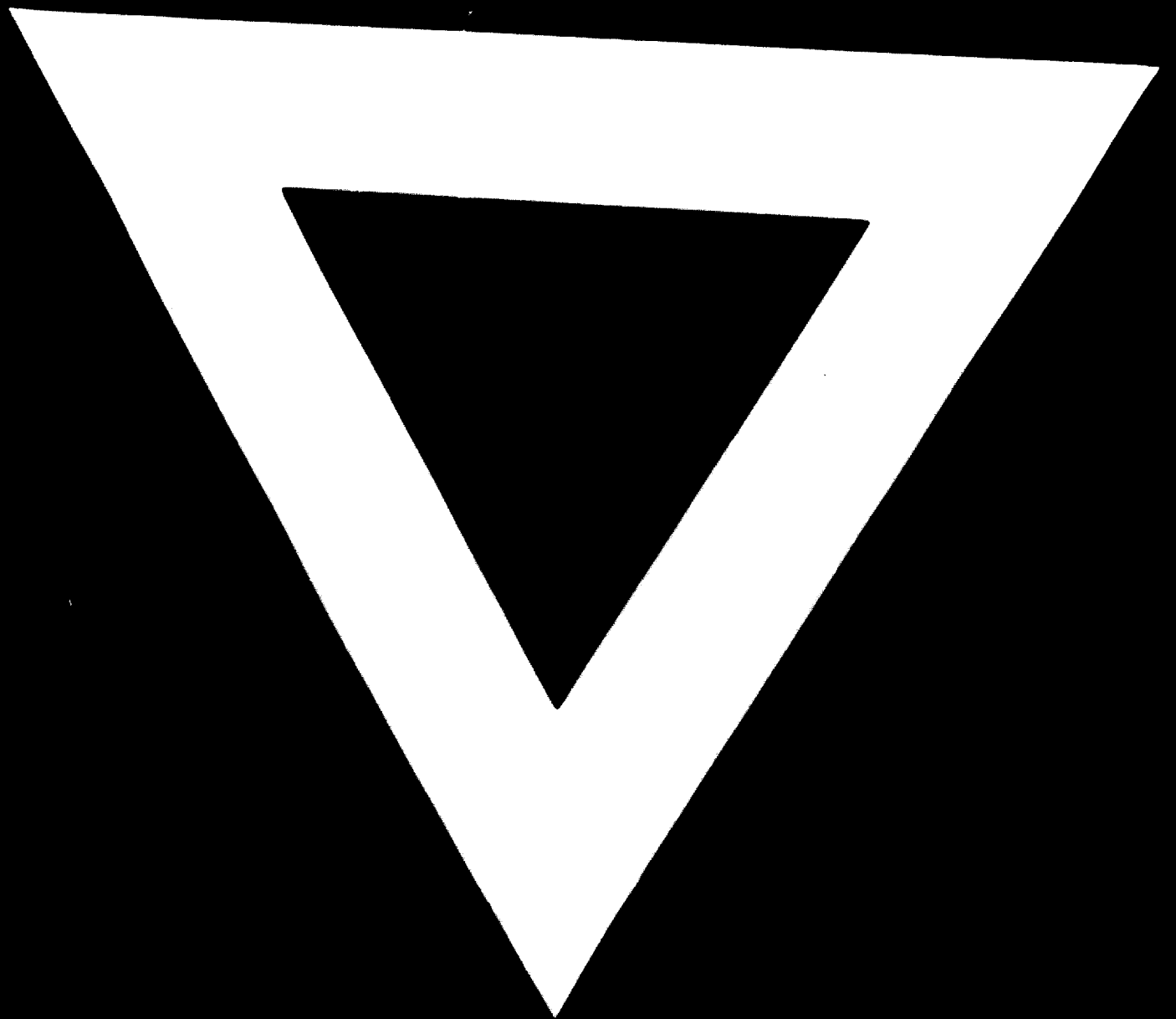
Scrap

At present, supply and demand with respect to scrap are nearly balanced in most of the Latin American countries. Exceptions are Mexico and Argentina, which import scrap for their semi-integrated plants. In 1971, Mexico imported about 500,000 tonnes of scrap, while Argentina imported around 50,000 tonnes.

Ferro-alloys

Although the Latin American countries are continuing to import ferro-alloys, it is important to note that their local manufacture has increased considerably in recent years. Argentina, Brazil, Chile and Mexico produce the basic ferro-alloys, ferro-manganese, ferro-silicon and silicomanganese with various proportions of manganese and silicon. Venezuela will be added to this list when it begins to manufacture these ferro-alloys this year. Brazil produces the widest range of special ferro-alloys, namely, ferro-nickel, ferro-chromium, ferro-titanium, ferro-tungsten, ferro-molybdenum, ferro-vanadium, ferro-niobium, silicon-calcium and silicon-calcium-manganese; Chile produces ferro-molybdenum and Mexico produces ferro-chrome and ferro-molybdenum.





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