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SOME CONSIDERATIONS ON THE DEVELOPMENT OF MACHINE TOOLS IN LATIN AMERICA[1/]

submitted by

the Secretariat of the Economic Commission
for Latin America (ECLA)

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CONTENTS

INTRODUCTION

On the occasion of the Regional Seminar on Machine Tools for countries in Latin America, UNIDO invited ECLA to submit a document on the possibilities opened up by integration or complementarity agreements for the manufacture of machine tools.

Despite the importance of the topic, at the moment insufficient data is available to produce a document of any real depth. Consequently, the scope of the document submitted is limited to providing some information concerning the Latin American machine tool market in its more general aspects and to establishing some relationships with the world market for these products. Estimates are given of the demand for machine tools in 1980, and these are related to the plans to intensify, in the region, the substitution of imports of manufactures and capital goods, which currently represent almost 43 per cent of total Latin American imports.

Then a qualitative analysis is made of the machine tool industry in Latin America, suggestions being put forward as to some aspects which deserve to be taken into consideration with a view to a more harmonious development of the sector. An attempt has been made to emphasize the advantages offered by regional co-operation in the endeavour to achieve a more dynamic industry. To this effect a study has been made of key elements such as the market, the size of enterprises, specialization in production, diversification of supply, analysis of the stock, progress in regional trade and the future of the industry.

I. APPARENT CONSUMPTION AND THE STOCK OF MACHINE TOOLS IN LATIN AMERICA

1. Apparent consumption of machine tools

The apparent consumption of machine tools rose from $195 million in 1968 to $238 million in 1970. This increase (22 per cent) is 13.6 per cent higher than the growth of the total gross product of the region over the same years. A very considerable factor in it was the determination of some countries to intensify the development of the engineering industries in order to displace imports of machinery and industrial equipment, which in 1969 amounted to more than $5,900 million, almost 43 per cent of the total imports of the region, and constitute a very heavy burden as far as the improvement of the regional economy is concerned.

Table 1 shows the variations recorded in apparent consumption and in production, imports and exports. Argentina, Brazil and Mexico were the chief consumers in the period surveyed, due to the fact that in those countries the engineering industries are more developed. In 1970 the apparent consumption of machine tools in those countries represented 82 per cent of the total for the region.

As far as the local production of machine tools is concerned, the table shows an increase which was reflected in a greater share of apparent consumption (25.6 per cent in 1968 and 27.3 per cent in 1970) and in increased exports.

Table 2 shows the value of the production of machine tools in Latin America. Argentina and Brazil are the major producers, followed by Mexico at a considerable distance. In the Andean subregion manufacture is still in the early stage, but since the subregion's industrial development prospects are very promising, it is hoped that the production of machine tools will attain a faster momentum.

It was not possible to obtain up-to-date figures for the different types of machine tools produced in the region. The figures collected are given in table 3.

Table 1

LATIN AMERICA: APPARENT CONSUMPTION OF MACHINE TOOLS

(millions of dollars)[b/]

	1968				1969				1970				1971[a/]			
	Production	Imports	Exports	Apparent consumption	Production	Imports	Exports	Apparent consumption	Production	Imports	Exports	Apparent consumption	Production	Imports	Exports	Apparent consumption
Argentina	22.7	10.0	1.6	31.1	29.2	23.0	1.4	50.8	32.4	35.4	2.0	65.8	34.3	30.7	2.1	69.9
Brazil	28.3	47.0	2.3	73.0	21.6	38.0	2.5	57.1	33.8	33.2	4.6	62.4	34.4	36.2	3.0	67.6
Mexico	2.2	43.0	-	45.2	4.3	46.9	0.1	51.1	5.0	62.4	0.1	67.3	5.0	64.3	0.1	69.2
Bolivia	-	1.7	-	1.7	-	0.5	-	0.5	-	0.6[a/]	-	0.6[a/]	...	...	...	...
Colombia	0.3	4.6	-	4.9	0.4	4.3	-	4.7	0.3	12.6	-	12.9	...	...	...	...
Chile	0.4	12.4	-	12.8	0.4	8.2	-	8.6	0.4	6.7	-	7.1	...	...	...	...
Ecuador	-	1.0	-	1.0	-	1.0	-	1.0	-	1.1[a/]	-	1.1[a/]	...	...	...	...
Peru	0.1	3.2	-	3.3	0.1	3.6	-	3.7	0.1	4.0[a/]	-	4.1[a/]	...	...	...	...
Venezuela	-	11.5	-	11.5	-	11.8	-	11.8	-	6.1	-	6.1	...	...	...	...
Other countries	-	10.7	-	10.7	-	9.1	-	9.1	-	11.0[a/]	-	11.0[a/]	...	...	...	...
Total	54.0	195.1	3.8	195.2	56.0	146.4	4.0	198.4	72.0	173.1[a/]	6.7	238.4[a/]	...	...	...	...

Source: Prepared on the basis of the figures in the following tables.

a/ Preliminary estimates.

b/ Import values are cif.

Table 2

LATIN AMERICA: PRODUCTION OF MACHINE TOOLS
(millions of dollars)

	1960	1963	1966	1968	1969	1970	1971
Argentina	...	8.9	...	22.7	29.2	32.4	34.3 a/
Brazil	26.5	...	...	28.3	21.6	33.8	34.4 a/
Mexico	...	0.2	1.5	2.2	4.3	5.0	5.0 a/
Andean subregion	...	...	0.6	0.8	0.9	0.8	1.0
Total	...	...	...	54.0	57.0	72.0	74.7 a/

Sources: American Machinist.

ECLA, La fabricación de maquinarias y equipos industriales en América Latina:IV. Las máquinas-herramientas en la Argentina, 1966.

ECLA, La fabricación de maquinarias y equipos industriales en América Latina:II. Las máquinas-herramientas en el Brasil, 1965.

Roberto Guzmán Martínez, Situación y perspectivas de la producción de una rama de bienes de capital en México: El caso de la industria de máquinas-herramientas, 1970.

a/ Preliminary

Table 3

LATIN AMERICA: DISTRIBUTION OF THE PRODUCTION OF MACHINE TOOLS BY LARGE CATEGORIES OF MACHINES

(Percentage of number produced)

	Argentina (1963)	Brazil (1961)	Mexico (1966)	Andean subregion (1970)
Lathes	30.2	36.3	7.3	8.8
Milling machines	1.8	1.7	-	-
Drilling machines	41.4	25.6	69.5	52.8
Boring machines	0.9	-	-	-
Planers	6.2	5.8	0.5	-
Threaders	0.3	0.4	-	-
Gear-cutting machines	0.1	-	-	-
Saws	3.6	9.0	-	10.8
Grinders	3.9	0.4	2.9	-
Tool sharpeners	1.2	0.4	-	-
Others	-	0.1	-	0.4
Sub-total, metal-cutting machines	89.7	79.7	80.2	72.8
Mechanical and hydraulic presses	7.9	16.2	9.5	9.0
Forging hammers	0.1	-	-	-
Sheet-working machines	1.6	4.1	10.3	14.9
Others	0.7	-	-	3.3
Sub-total, metal-forming machines	10.3	20.3	19.8	27.2
Total	100.0	100.0	100.0	100.0

Sources: ECLA, La fabricación de máquinarias y equipos industriales en América Latina: IV. Las máquinas-herramientas en la Argentina, 1966.

ECLA, La fabricación de maquinarias y equipos industriales en América Latina: II. Las máquinas-herramientas en el Brasil, 1961.

Industrial Programming Administration, Nacional Financiera S.A., 1967.

The fob value of imports of machine tools is given in table 4. Salient features are the volume of Mexican imports to make up for that country's limited production and the growing import trends in Argentina and Brazil, where the average annual growth rates are 25 and 20 per cent respectively for the period 1965-1970.

Although exports of machine tools by those Latin American countries which manufacture them are small (see table 1), there is no doubt that they will increase in future if manufacturers manage to improve their production facilities and their competitiveness in regard to similar products imported from outside the region.

If Latin American consumption is compared with consumption in the nine major machine tool consuming countries in the world (see table 5), it will be noted that the region would occupy eighth place.

In 1971 world production of machine tools reached $7,781.5 million, according to estimates made by the American Machinist; thus it fell, for the first time in history, almost 1 per cent in comparison with the 1970 figure. The Federal Republic of Germany was the principal producer, with $1,820.0 million (23.4 per cent of the world total). The Soviet Union, without increasing its production significantly, took over second place from the United States, a country which considerably reduced its production from $1,443.1 million to $980.0 million. The five major producers manufacture approximately 70 per cent of these machines.

Of total world production, 73.5 per cent ($5,720.1 million) is accounted for by metal-cutting machines, and 26.5 per cent by metal-forming machines. This proportion has remained fairly constant in the past few years, with a slight tendency for the share accounted for by metal-forming machines to increase (see table 6).

Table 4

LATIN AMERICA: IMPORTS OF MACHINE TOOLS
(millions of dollars fob)

	1965	1966	1968	1969	1970	1971
Argentina	9.8	12.4	8.3	19.2	29.5	25.6 a/
Brazil	11.3	17.5	39.2	31.7	27.7	30.2 a/
Mexico	36.3	28.1	35.8	39.1	52.0	53.6 a/
Bolivia	0.3	0.2	1.4	0.4	...	...
Colombia	3.7	2.8	3.8	3.6	...	...
Chile	5.1	4.9	10.3	6.8	...	...
Ecuador	0.5	0.8	0.8	0.8	...	...
Peru	3.4	3.9	2.7	3.0	...	...
Venezuela	7.7	7.6	6.0	5.8	...	...
Other countries	9.4	9.6	13.3	13.1	...	...
Total, Latin America	87.5	87.5	121.0	123.5	145.2	...

Source: Bulletin of Statistics on World Trade in Engineering Products, 1965, 1966, 1968, 1969.

a/ Preliminary estimates

Table 5

PRINCIPAL "CONSUMERS" OF MACHINE TOOLS, 1971
(millions of dollars)

Country	Value
Soviet Union	1,260
Federal Republic of Germany	1,110
Japan	942
United States	812
France	478
Italy	413
United Kingdom	367
Czechoslovakia	207
Poland	178

Source: American Machinist

PRODUCTION OF MACHINE TOOLS IN SELECTED COUNTRIES

(Million dollars)

	1971			1970		
	Total	Metal-cutting	Metal-forming	Total	Metal-cutting	Metal-forming
1. Federal Republic of Germany	1 820.0	1 230.0	590.0	1 479.0	1 018.4	460.6
2. Soviet Union	1 160.0	865.0	295.0	1 073.0	803.0	270.0
3. United States	980.0	662.0	318.0	1 443.1	992.9	450.2
4. Japan	912.0	722.0	190.0	1 109.4	867.4	242.0
5. United Kingdom	465.0	367.0	98.0	476.9	378.5	98.4
6. Italy	423.0	338.0	85.0	433.6	346.9	86.7
7. France	387.0	273.0	114.0	316.5	240.5	76.0
8. Czechoslovakia	275.0	230.0	45.0	250.0	210.0	40.0
9. Switzerland	266.0	226.0	40.0	242.0	206.0	36.0
10. German Democratic Republic	260.0	193.0	67.0	252.3	185.7	66.0
11. Poland	145.0	132.0	13.0	123.0	112.0	11.0
12. Spain	98.0	83.0	15.0	88.6	77.5	11.1
13. Sweden	79.0	51.0	28.0	66.0	43.0	23.0
14. China	58.0	43.0	15.0	52.0	-	-
15. Hungary	47.3	44.3	3.0	44.6	41.6	3.0
16. India	45.0	42.5	2.5	31.2	29.3	1.9
17. Belgium	37.4	17.7	19.7	33.9	16.3	17.6
18. Canada	37.0	22.0	15.0	34.9	21.1	13.8
19. Yugoslavia	36.3	29.0	7.3	26.0	22.5	3.5
20. Brazil	34.4	20.0	14.4	33.8	19.6	14.2
21. Argentina	34.3	19.1	15.2	32.4	18.0	14.4
22. Mexico	5.0	-	-	5.0	-	-
Total	7 781.5	5 720.1	2 056.4	7 803.7	5 744.8	2 001.9

Source: American Machinist

The principal importers of machine tools are the industrialized countries. In 1971, out of a total $2,619.9 million worth imported, the developed countries[1] accounted for 72 per cent, while the socialist countries[2] accounted for 19 per cent, and the developing countries and territories for 9 per cent. These figures show that the main market for machine tools is in the industrialized countries themselves.

2. The stock of machine tools

In Latin America the main stocks of machine tools are in Argentina, Brazil and Mexico, but they are small in relation to those in the industrialized countries and there are very few machines incorporating the latest technological advances, mainly because the current market does not justify it. Thus, when a comparison is made between the stocks of the Latin American countries and those of the industrialized countries, a quantitative criterion is not enough; the problem also has to be approached from a qualitative point of view.

It is estimated that in 1970 the Latin American stock of machine tools reached 700,000 units (see table 7).

A large percentage of the world stock of machine tools is concentrated in the industrialized countries, which also have the machine tools of advanced design for manufacturing more complex metalworking products. Table 8 shows the stock of machine tools in certain industrialized countries.

Estimating long-term future demand is a complex operation because it is necessary to consider the level of economic development attained by the country concerned, the nature of its productive structure, and the possible changes that may occur therein in the course of its development. Consequently, the figures given in the table, obtained from the projection shown in annex 1, must not be considered definitive; it is recommended that they should be periodically revised, both for the region as a whole and for each country individually.

1/ United States, Canada, Western Europe, South Africa, Japan, Australia and New Zealand.

2/ Socialist countries of Eastern Europe.

Table 7

STOCK OF MACHINE TOOLS IN CERTAIN LATIN AMERICAN COUNTRIES
(Units)

	Year	Stock of machine tools
Argentina	1963	171 556 a/
	1969	210 000 b/
Brazil	1960	149 414 c/
	1968	243 800 d/
	1969	260 000 b/
Mexico	1960	63 472 e/
	1964	82 565 e/
	1968	110 000 b/
Colombia	1964	21 394 f/
	1967	23 000 b/
Chile	1960	12 044 g/
	1968	20 760 b/
Andean subregion	1968	60 000 b/
Venezuela	1968	22 000 b/

Sources:

a/ ECLA, La fabricación de maquinarias y equipos industriales en América Latina: IV. Las máquinas-herramientas en la Argentina, 1966.

b/ Estimated on basis of personnel employed in the metalworking industry.

c/ ECLA, La fabricación de maquinarias y equipos industriales en América Latina: II. Las máquinas-herramientas en el Brasil, 1962.

d/ IPEA

e/ Nacional Financiera S.A., Industrial Programming Administration, 1965.

f/ La industria mecánica de Colombia, ECLA/ILPES/IBRD, 1966.

g/ Equipo de máquinas-herramientas en la industria metalúrgica nacional, ICHA, 1962.

h/ Inventario nacional de máquinas-herramientas y otros equipos de uso común para la transformación de metales. Comisión de Productividad de la Industria Metalúrgica, 1960.

Table 8

STOCK OF MACHINE TOOLS IN CERTAIN INDUSTRIALIZED COUNTRIES
(Units)

	Year	Stock of machine tools
United States	1968	3,600,000 a/ b/
	1968	2,870,000 a/ c/
Japan	1963	886,313 d/
	1966	1,100,000 e/
United Kingdom	1961	1,113,330
	1968	1,300,000 e/
Federal Republic of Germany	1966	1,300,000
	1968	1,700,000 e/
France	1960	404,500
	1968	740,000 e/
Italy	1958	362,811
	1968	475,000 e/
Hungary	1970	115,000 f/

Sources:

a/ The Tenth American Machinist Inventory of Metal Working Equipment, American Machinist, 1968.

b/ Includes all machine tools available.

c/ Includes only machine tools used by the metalworking industry.

d/ A study of the Technology Gap, Research Institute, Japanese Society for the Promotion of the Machinery Industry, 1968.

e/ Estimated on the basis of the personnel employed in the metalworking industry. Other figures: La fabricación de maquinarias y equipos industriales en América Latina, las máquinas-herramientas en el Brasil, 1962.

f/ Andrés Koltai, Country Study Report on the Machine Tool Industry in Hungary, UNIDO, 1971.

Among the different methods commonly used to determine demand projections, we have adopted a procedure which relates the stock of machine tools to the personnel employed in the metalworking industry. This procedure has already been used in previous works.[3/] Projections were calculated for two growth assumptions (gross domestic product and gross domestic product per capita) the values obtained are given in table 9.

In 1980 demand could require a stock of between 2.75 and 3.35 million units. The foreseeable increase is very large for the region as a whole, since it entails passing from a stock of 0.7 million units in 1970 to at least 2.75 million units in 1980; in other words, the stock would have to grow at an average annual rate of 14.7 per cent. In the case of the maximum growth assumption it would have to increase at an average annual rate of 17.0 per cent.

A growth such as that envisaged implies substantial investments, which will have to be provided, primarily, out of local production, since almost all Latin American countries suffer from a shortage of foreign exchange. The future of the machine tool industry and its chances of meeting the anticipated demand will depend on the internal resources available to enterprises, the support granted to them by the State, the consideration given to it by international financial agencies, and the way in which production is expanded so that resources are used with maximum efficiency.

3/ Las máquinas-herramientas en el Brasil, 63.II.G.4; Las máquinas-herramientas en la Argentina, 66.II.G.4; La industria mecánica en Colombia (E/CN.12/791).

Table 9

LATIN AMERICA: ESTIMATES OF STOCK OF MACHINE TOOLS IN 1980
(thousands of units)

	Minimum assumption	Maximum assumption
Argentina	340.0	440.0
Brasil	1,100.0	1,400.0
Mexico	560.0	610.0
Andean Group		
Bolivia	3.8	4.8
Colombia	80.0	110.0
Chile	135.0	155.0
Ecuador	12.0	15.5
Peru	40.0	49.0
Venesuela	340.0	420.0
Other countries	140.0	150.0
Total, Latin America	2,750.8	3,354.3

Source: ECLA, on basis of official statistics

II. THE EXISTING INDUSTRY AND REGIONAL CO-OPERATION FOR ITS FUTURE DEVELOPMENT

Among the most important factors which appear to have held up the development of the machine tool industry is the small size of the market, aggravated by constant market fluctuations in regard to the type of machines required. This has led to a lack of specialization and the under-dimensioning of enterprises, with the consequent technological backwardness. The integration and complementarity agreements, which should make it possible for markets to expand, would give enterprises a chance to grow and would facilitate specialization, as well as the introduction of new technologies.

As has been seen in the previous chapter, the Latin American stock of machine tools, estimated to be 700,000 units, would reach 3,000,000 units in the next decade. In order to achieve this increase, an annual average of approximately 230,000 machines would have to be incorporated, which entails an investment of nearly $900 million a year. This means that current apparent consumption, which is in the region of $240 million, would rise fourfold. Such a growth in consumption may seem too high in the light of the region's traditional growth rate, but it must be borne in mind that in this decade the development of the metalworking industries, particularly as far as capital goods are concerned, will receive special attention owing to the obvious need to intensify the substitution of foreign machinery and equipment, imports of which amounted to almost $6,000 million in 1969. As machine tool manufacture is generally in the early stage, initially a considerable volume of foreign exchange will be required to import such machines, but subsequently, with a more developed production and a qualitatively more comprehensively more comprehensive stock, there is reason to hope that local production will reduce Latin America's dependence on outside sources in respect of these goods.

With a few important exceptions, Latin American enterprises are small; this would not be a limitation if there were a supporting infrastructure which permitted them to develop specialized operations, as happens in a number of the world's major producing countries. However, as this is not the case in the Latin American countries, it can be said that the size of enterprises represents a limiting factor as far as the progress of the machine tool industry is concerned. Its effects are noted in a number of internal problems. Thus, there is very little research and design activity. Many

enterprises are concerned almost exclusively with imitating, copying and simplifying foreign models, using defective and incomplete means of production. Also, importance is not attached to marketing. There is little knowledge of sales organization. Small enterprises can develop successfully in a restricted market, but it is difficult for them to do so in an integrated market in which there are great distances between individual centres of consumption.

Not all enterprises are engaged solely in the manufacture of machine tools, regardless of the size of establishments. Since they do not have a sufficiently large and continuous market, enterprises have to resort to other lines of production in order to attain a better yield on investments. There is also the case of the many workshops which originally manufactured other products but which began to produce machine tools while continuing to manufacture their original products. Obviously, all this implies a very low level of specialization.

There have been few changes in this situation over the past decade in the principal producing countries of Latin America. For example, in Argentina, of the 86 major manufacturers analysed in 1963, 55 had a single line of production, while the remaining 31 had two or more. The same proportion was maintained in 1970, even though there was a tendency for manufacturers to diversify their production by manufacturing different machine tools instead of specializing more in the numerous variants on a given type and model of machine.

In Brazil, of the 99 enterprises analysed in 1961, 62 per cent accounted for more than 75 per cent of the sales value of machine tools, while the other 38 per cent accounted for smaller proportions. In 1968 IPEA made a new analysis and arrived at the conclusion that, of 83 enterprises, 56 per cent accounted for no less than 75 per cent of total invoiced sales of machine tools.

The production of machine tools in Latin America is not very diversified and the models manufactured are mainly machines of the "universal type". A comparison between the productive structure of machine tools in the developed countries and the productive structure in Latin America clearly shows the structural deficiency of supply in the latter. From this it should not, however, be concluded that self-sufficiency in machine tools should be sought, since it is an intrinsic characteristic of the sector that even the developed countries carry on between them a fairly intensive trade in this type of goods.

As a first step within a scheme for regional specialization, specialization in production should be aimed at. The fact that many small- and medium-scale enterprises manufacture the same products leads to under-utilization of their installed capacity, which can well be used in the production of other machine tools, provided they have the technological know-how. The stage of development attained by the Latin American machine tool industry, which is concentrated in Argentina, Brazil and Mexico, is such that good results can be expected both from internal rationalization processes and as far as inter-regional trade is concerned.

An outstanding strategic role in this process of rationalization could be played by specialized institutes that might be established for the purpose of doing work and supplying services which individual enterprises are not in a position to handle themselves and to provide guidance in regard to the process itself. Institutes of this type already exist in Argentina and Brazil, but in other countries due importance has not yet been attached to them. This should not be interpreted to mean that all countries should have bodies of this kind, but that consideration should at least be given to a few institutions of a subregional nature to serve, for instance, the Andean Group and the Central American Common Market.

These institutes could, in their respective countries and areas of influence, participate in the formulation of the sector's development policies, which in turn should be compatible with the integration process. They could fulfil functions such as the following:

Market research. In order to carry out an effective integration programme, there must be a constant flow of information between governments, users and manufacturers. The State, as an investor and as a catalyst of private investment, the user, as a producer of machinery and equipment, and the machine tool manufacturer as a supplier, must keep in constant touch with one another. The pertinent arrangements could be made through the institutes, which would thus acquire a better knowledge of the market and be able to guide machine tool manufacturers in determining the types of machines in greatest demand and their corresponding technical specifications.

Selection of types of machine tools. An important function which these institutes could fulfil, especially in the initial stage, is to assist with the selection of the most suitable machines to be produced locally or, failing that, to be imported. In the

region there is a widespread practice of resorting, in this matter, to the machine tool sellers themselves. The latter often place orders for machines which greatly exceed the requirements of the users, oblige them to make a larger investment - which subsequently leads to financial difficulties - and makes them adopt a production technology which is not always in accord with local conditions. Apart from this, serious damage is done to the machine tool industry itself, and its development prospects are restricted. The tied credit system has also been a serious limitation on the local industry's development.

Standardization of parts. The institutes could also help with the standardization of parts. This would facilitate the introduction of the mass production techniques which are being introduced in the developed countries and which represent an important step forward in the production and cost of machine tools. It entails the establishment of specialized supplier enterprises which would take maximum advantage of the greater volume of production. This work involves the participation of highly qualified technical personnel and a substantial and decided collective effort by manufacturers.

Research and development. In the initial stage, instead of thinking of developing and designing new machines, the institutes should promote and participate in the establishment of the most suitable systems for obtaining the most appropriate technology for the local manufacture of machine tools, examining the choice between purchasing basic technology, obtaining it through association with foreign investors who have the technological know-how, acquiring it through foreign technical assistance or through the payment of licenses, or developing, within the country or region, the research capacity considered most appropriate. Co-operation between the institutes could be an important way of arriving at proposals for harmonious regional policies which would subsequently facilitate the regional integration process.

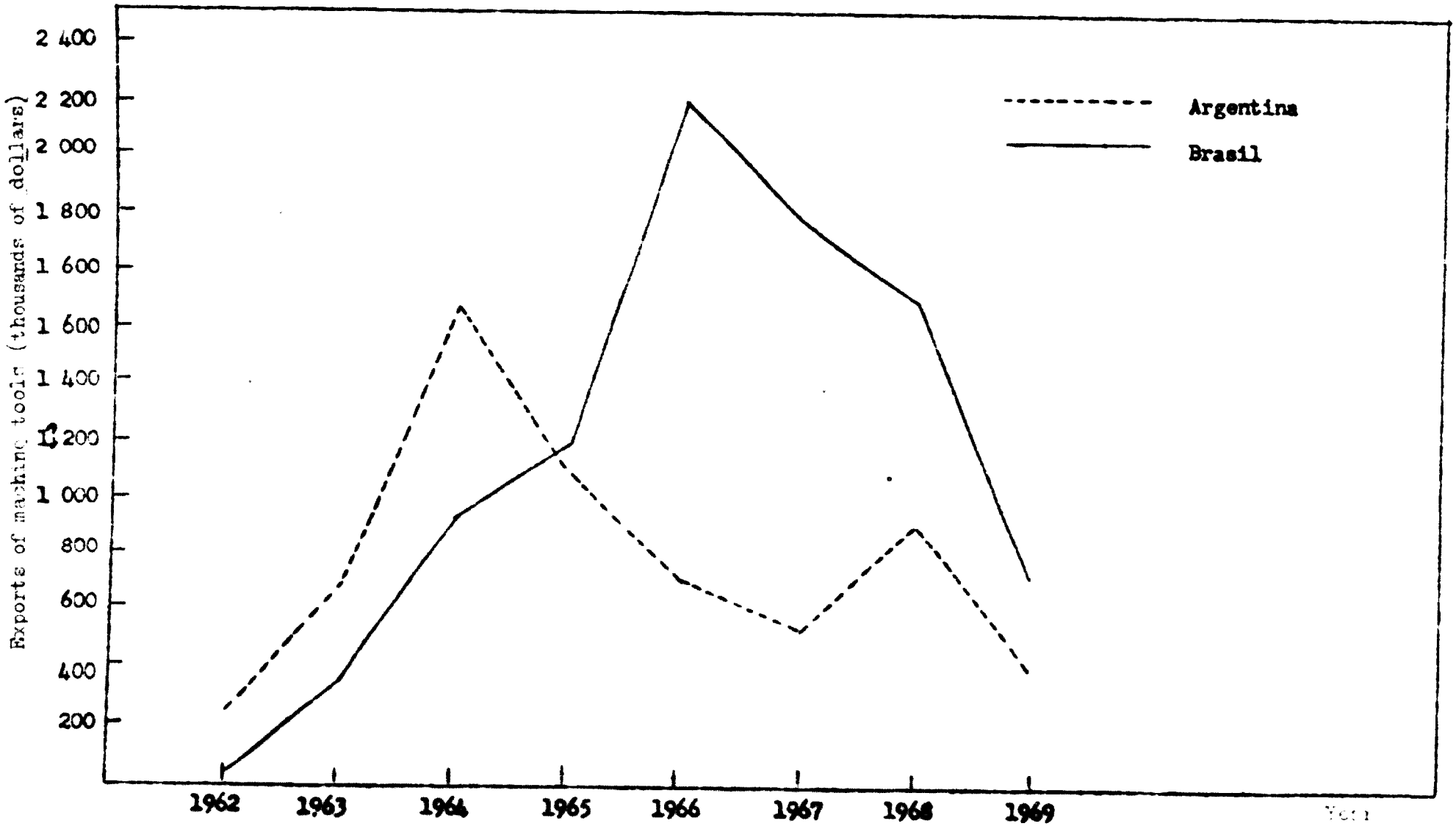
In conclusion, it is considered that these institutes should have a fundamental role in guiding the machine tool sector by gearing it to meet the requirements which will arise from the development of the metalworking industries. The present stock of cutting machines held by these industries contains a large proportion of lathes, drilling machines, planers and saws, which indicates an industrial structure in which there is a predominance of low-output activities employing general-purpose machinery. As the metalworking industries progress, the proportion of universal machines will fall, such machines being replaced by other, technologically more advanced, types required for longer production runs. It is precisely at this stage that the greatest advantages of integration could be exploited.

The emphasis on the role of these institutes as a means of obtaining maximum benefit from the opportunities to be derived from the Latin American market, through action that would have to be taken at both the national and regional levels, arises from the conviction that such a process will not come about as the result of a lowering of Customs tariffs or other similar measures. Experience shows that the concessions granted within LAFTA, for example, of different degrees and covering various types of machine tool, have not had the anticipated effect, either on trade or on the promotion of new products. It is true that some concessions are minimal, but others have been considerable, as is the case with universal engine lathes. It is also true that exports of machine tools from the principal LAFTA producers to the other countries in the region grew rapidly between 1962 and 1966, but they subsequently fell to levels slightly above those recorded at the beginning of the decade (see graph 1). This would indicate that tariff considerations alone are not enough, and that it would be necessary to adopt parallel measures designed to change the productive structure and to adjust it to market requirements. Some of these measures will be technical and economic, such as those already mentioned; others will be financial or related to the co-ordination of national programmes and policies for developing the industry.

It is clear that the lack of a financing system appropriate to the needs of the industry, in terms of both the amounts of credit available and the arrangements for obtaining it has constituted a serious obstacle to the industry's development. Special attention will also have to be paid to this aspect -- as some countries have already begun to appreciate - and some kind of regional action will be needed. The production of this type of goods, like others which are subject to constant technological innovation, requires substantial financial support from the moment the factory is installed, the prototypes of the models to be produced are built, and manufacturing proper begins, up to the point where the product is marketed at home or abroad. It is possible that, in this matter and in others of a technical and economic nature, the multinational enterprise might constitute one of the appropriate ways of attaining the sector's future development in the context of regional co-operation and integration. The idea behind making this a basic objective to be attained is not to solve a problem of scale, since that is not a determining factor in the manufacture of machine tools, but rather the conviction that co-operation of this kind would not only make it possible to make better use of the resources available in individual countries but would also serve as an instrument for co-ordinating national production plans and programmes with regional interests.

Graph I

EXPORTS FROM ARGENTINA AND BRAZIL TO THE LAFTA COUNTRIES



Source: LAFTA, Programa de liberación de intercambio. Tomo I"

Emphasis has been laid of the [illegible] attain as a result of the anticipated development of the metalworking industries in general and of the manufacture of machinery and equipment in particular, the latter currently representing a very considerable proportion of imports. The figures quoted provide a powerful stimulus for the manufacture of machine tools, in the light of what they mean in regard to the potential market for machine tools over the next ten years. However, they also reveal the magnitude of the effort which would have to be made in the region in order to obtain an even greater share of this market, having regard for the fact that the predominant characteristic of the market will be the variety, technology and quality of the goods which will be required.

If the machine tool industry is to be able to benefit from this future regional market, it is essential that it should plan its development in qualitative terms. This necessarily implies a very high degree of responsibility at the industry and enterprise levels as far as productive management is concerned; at the country level in regard to the formulation of national plans and policies for development, and in regard to the creation of an adequate infrastructure to endow the industry with the necessary conditions to enable it to meet demand, and at the regional level in regard to the co-ordination of these programmes and the establishment of a system and standards so that maximum benefit can be derived from the expanded market.

At this point there is no need to emphasize that in this effort considerations as to the cost and price of the end products must also be borne in mind, not only because of their significance for the sector's internal efficiency targets, but also, and most importantly, because of their effects on efficiency in the rest of the economy. Since machine tools are characteristically used for the manufacture of other goods - and in this case preferably capital goods - any inefficiency in regard to the prices at which machine tools can be obtained on the world market will inevitably be reflected in higher costs of the goods which they generate, and through these the inefficiency will spread to the economy as a whole. This raises a serious problem of planning and decision-taking in regard to the determination of what it would be advisable to produce and what it would be advisable to continue to import. In many cases the reply to this question will have to be based on an examination of the regional situation, since the markets of individual countries, and even of subregional integrated groupings, are restricted. There is no need to stress the additional advantage to be derived from a cost-efficient industry - namely, the ability to enter, and profit from, the international market.

[illegible] incomplete and superficial manner in view of the importance of the topic to be discussed, is intended to make it clear that the industry's future [illegible] extensive and promising, but that for many countries [illegible] depended on regional action. In addition, in this latter connection [illegible] to a number of forms which this action could take and to the fields in which it is most urgently and specifically required, but without establishing any [illegible] providing a definite and concrete solution to the problems which [illegible]. The role it has been to outline a situation which calls for immediate attention owing to its complexity and importance for the industrial development of the region and, at the same time, to pose a series of questions which require a more detailed and better documented analysis before any specific proposals can be discussed. Any other objective beyond this would have been, at this stage, over-ambitious as it would have had a very relative practical value. The information available is insufficient and does not permit of greater precision in the conclusions. Here too, a great deal of research would have to be done before the bases of a regional co-operation programme can be laid down. This, however, will not be impossible or difficult to achieve if there is a determination and conviction that such regional co-operation constitutes the most appropriate approach to the future development of machine tool manufacturing. This Latin American seminar is therefore a timely event and provides an opportunity to discuss the problem and to establish the course of the long-term, medium-term action which should be taken. The presence of representatives from the industry and from government bodies, and of experts of immense and recognized experience in the matter, will make it possible to examine the topic from the many and varied angles involved and to draw conclusions as to the viability of a regional programme and as to the international aid and co-operation which would eventually be required for it.

ESTIMATES OF LATIN AMERICAN REQUIREMENTS
OF MACHINE TOOLS IN 1980

It was decided to use the same methodology applied by ECLA in previous works on the topic, modified only so that it could be used with current statistical information. Fundamentally, this methodology relates the stock of machine tools to the personnel employed in the metalworking industry.

In order to determine the potential personnel to be employed, it was necessary to establish the value added by the engineering industry. For this purpose graph II was used, it relates the value added by the engineering industry to the per capita income[1/], graph III relates the value added in the engineering industry to the personnel employed in them. There is no need to point out that the graphs must be used with the appropriate reservations.

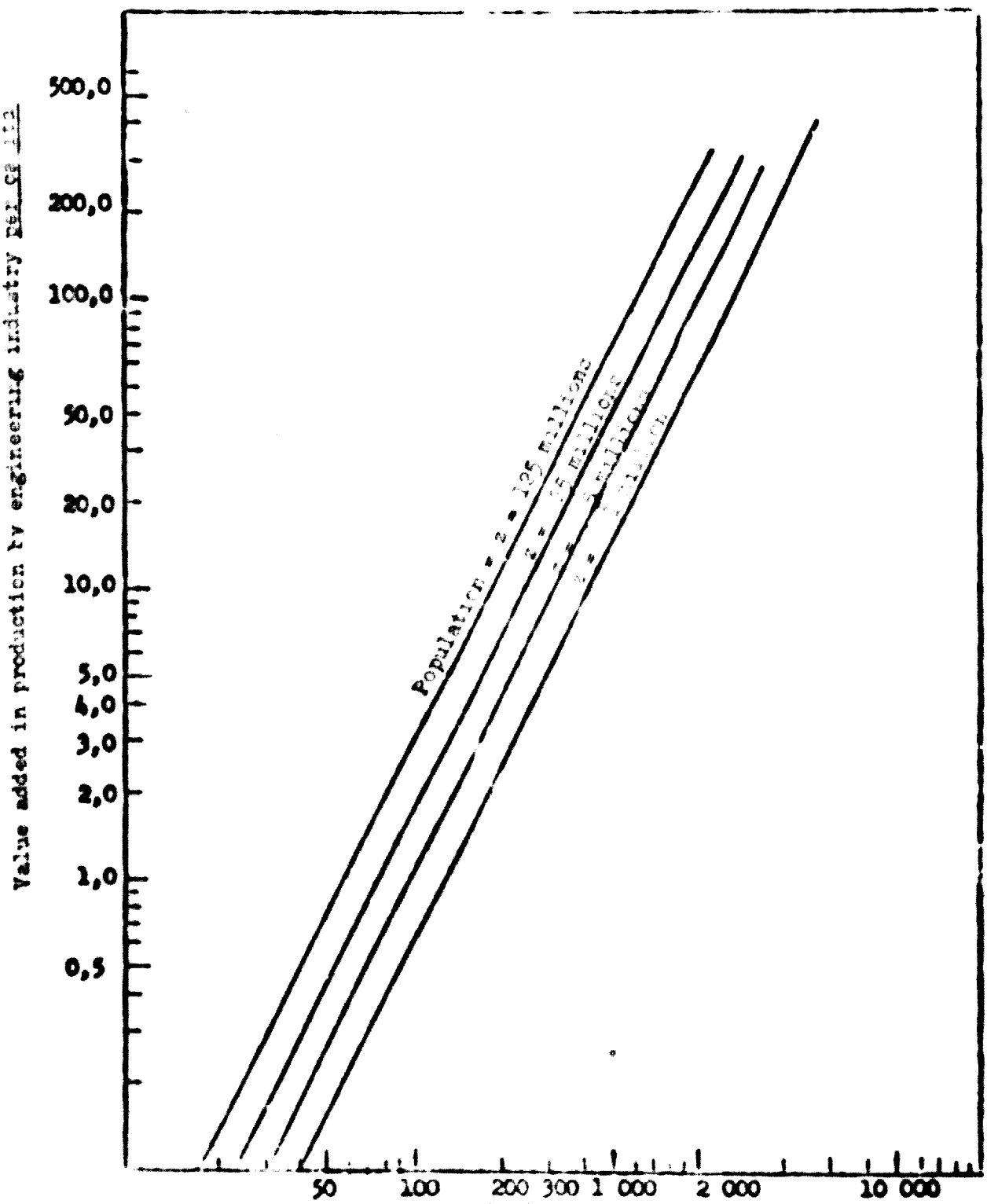
The relationship between the personnel employed in the engineering industry and the stock of machine tools is shown in graph IV. This relationship is fairly constant and does not appear to be subject to substantial variations from one country to another as the result of structural, technological and other differences. Of course, no general conclusion can be drawn, apart from the fact that it is not possible to judge whether the small differences recorded are the result of statistical deficiencies. However, it is generally consistent with what is usually found in the metalworking industries, namely, that the number of machine tools in service is in direct proportion to the number of personnel employed, in the ratio of 2% machines for every 100 persons (1 machine for every 4 persons).

In view of the foregoing, it is clear that the quantity of machine tools required in the next decade will be closely connected to the level of economic development attained by the countries in general, and, in particular, to the development of the metalworking industries, which are their chief consumers.

1/ See Industrialization of Developing Countries: Problems and Prospects, Engineering Industry, UNIDO Monographs on Industrial Development, No. 4, United Nations, 1969.

Graph II

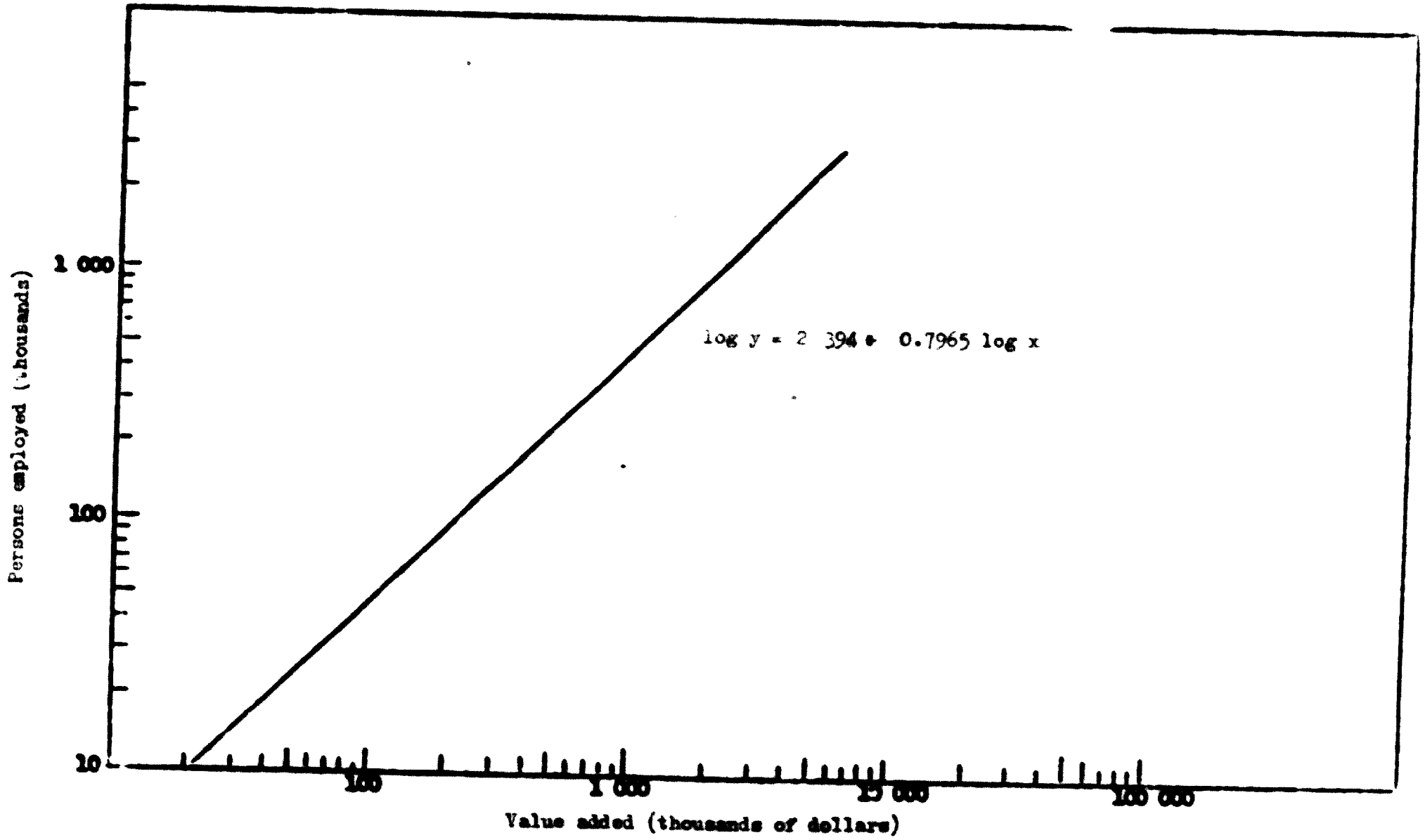
VALUE ADDED IN [illegible] PRODUCTION BY INFLATION
[illegible]



Source: UNIDO Monograph: Industrialization of Developing Countries: [illegible]

Graph III

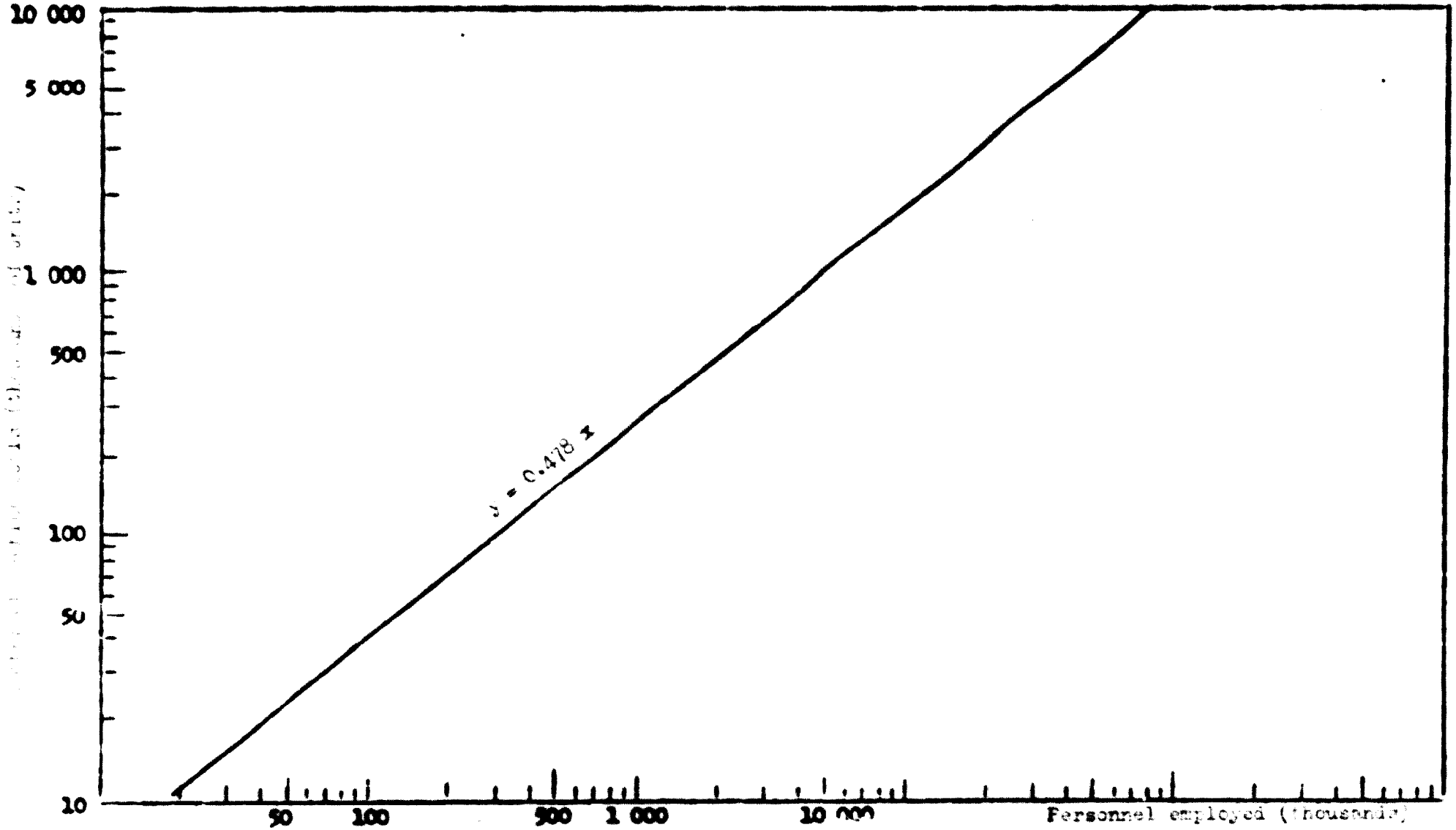
RELATION BETWEEN PERSONNEL EMPLOYED AND VALUE ADDED IN THE ENGINEERING INDUSTRY



Source: United Nations: The Growth of World Industry, 1968 and 1969, Edition - Vol. I, IMF: International Financial Statistics.

Graph IV

RELATION BETWEEN THE NUMBER OF MACHINE TOOLS AND THE PERSONNEL EMPLOYED IN THE METALWORKING INDUSTRY



Source: ECLA. La fabricación de maquinarias y equipos industriales en América Latina. II. Las máquinas-herramientas en el Brasil.

Estimates of the gross domestic product and the gross domestic product per capita in 1960 for several countries and for Latin America as a whole are given in table A. As there are two assumptions (minimum and maximum), the projected demand for machine tools will also have two values as shown in table B.

Table A

LATIN AMERICA: GROSS DOMESTIC PRODUCT AND GROSS DOMESTIC PRODUCT PER CAPITA IN 1960

	Gross domestic product		Population	Gross domestic product per capita	
	Minimum assumption	Maximum assumption	(Thousands of inhabitants)	Minimum assumption	Maximum assumption
	(millions of dollars, 1960)			(dollars, 1960)	
Argentina	24,788.4	30,424.4	28,218	878	1,078
Brazil	76,471.9	92,189.5	124,000	617	743
Mexico	44,243.0	46,364.3	71,387	620	649
Andean Group					
Bolivia	1,010.0	1,146.3	6,006	168	191
Colombia	10,519.5	12,168.5	31,366	335	388
Chile	9,393.5	11,289.6	12,213	769	924
Ecuador	2,149.1	2,510.0	8,440	255	297
Peru	5,935.1	6,521.4	18,527	320	352
Venezuela	19,434.6	22,056.4	14,979	1,297	1,473
Other countries	14,392.9	15,039.5	34,886	413	431
Total, Latin America	208,338.0	240,709.2	367,573	567	686

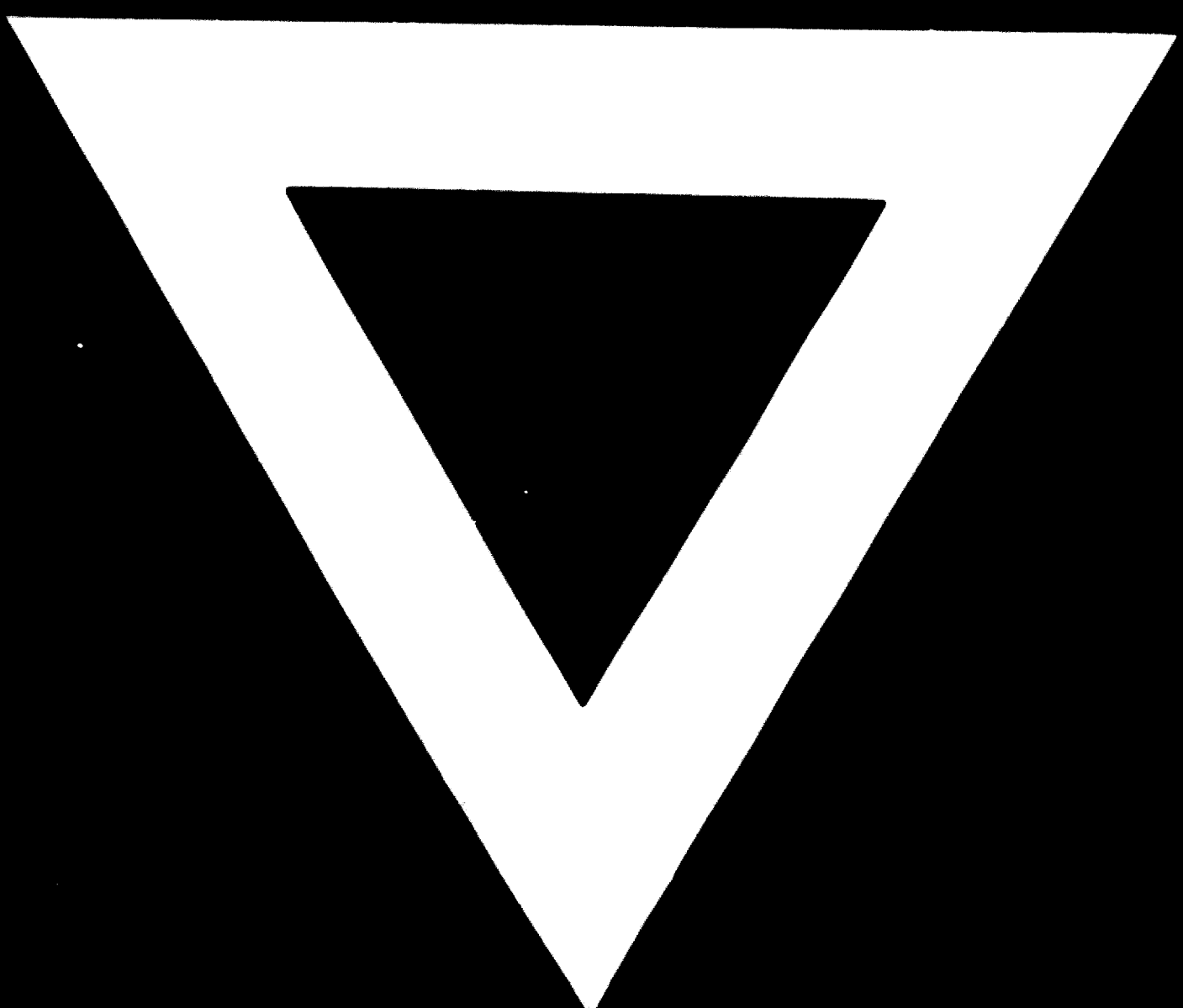
Source: ECLA, Latin America Macroeconomic Projections for the 1970s (E/CN.12/865); ECLA, Statistical Bulletin for Latin America, Vol.VIII, No.2.

Table B

LATIN AMERICA: ESTIMATES OF MACHINE TOOL STOCK, 1980

	Minimum assumption				Maximum assumption			
	Per capita product (dollars, 1960)	Value added (thousands of dollars, 1960)	Personnel employed (thousands of inhabitants)	Stock of machine tools (thousands)	Per capita product (dollars, 1960)	Value added (thousands of dollars, 1960)	Personnel employed (thousands of inhabitants)	Stock of machine tools (thousands)
Argentina	130	3,[illegible]0	[illegible]70.0	340.0	160	4,000	[illegible]0.0	[illegible].0
Brazil	[illegible]	12,250	[illegible],200.0	1,100.0	140	17,[illegible]00	[illegible],[illegible]0.0	[illegible],[illegible].0
Mexico	78	5,460	1,100.0	560.0	85	5,[illegible]50	1,[illegible]0.0	[illegible].0
Andean Group								
Bolivia	[illegible]	15	8.4	3.8	4	[illegible]	10.[illegible]	[illegible].
Colombia	15	540	100.0	80.0	25	750	[illegible]0.0	1[illegible].
Chile	80	[illegible]00	[illegible]70.0	135.0	105	1,[illegible]60	[illegible]0.0	1[illegible]5.0
Ecuador	7	[illegible]0	25.0	[illegible]2.0	10	[illegible]0	[illegible].0	[illegible].
Peru	13	[illegible]80	80.0	40.0	1[illegible]	[illegible]8	98.0	[illegible].[illegible]
Venezuela	200	3,000	[illegible]70.0	340.0	260	[illegible],[illegible]00	[illegible]40.0	[illegible].0
Other countries	[illegible]8	[illegible]80	[illegible]70.0	140.0	32	1,[illegible]20	[illegible]00.0	1[illegible].
Total Latin America			5,453.4	2,750.8			[illegible],[illegible]2[illegible].5	[illegible],[illegible].

Source: ECLA, on the basis of official statistics.



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