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Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

Distr.
LIMITED

ID/WG.508/4(SPEC.)
15 November 1990

ENGLISH
ORIGINAL: SPANISH

18846

United Nations Industrial Development Organization

Regional Expert Group Meeting for
Latin America on the Capital Goods
Industry, with Special Emphasis on
Machine Tools

Santiago de Chile, 8-11 April 1991

SUPPLY AND DEMAND FOR MACHINE TOOLS IN LATIN AMERICA, OPPORTUNITIES AND POLICIES FOR CO-PRODUCTION PROJECTS*

Prepared by the
Latin American Economic System (SELA/LAES)

* This document is a translation of an unedited original.

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Marti, C.E.

CONTENTS

I. INTRODUCTION

Machine tools (hereinafter MT) form a small proportion of the output of capital goods even in countries which are leaders in world production. In Japan, which is the foremost world manufacturer, the industry only employed 32,705 people with production valued at $US 6,419 million in 1987 (NMTBA, 1988). In the Federal Republic of Germany, the second producer and first exporter in the world, the industry accounted for only 1.4 per cent of manufacturing employment and 0.61 per cent of GDP (OECD, 1983). On the other hand, imports of MT represented 2.39 per cent of world imports of capital goods in 1980 (declining to only 1.71 per cent in 1985) (Chudnovsky, 1988a).

The importance of this industry arises not from its economic impact but from its exceptional technological contribution. MT are instruments for the manufacture of machines and manufacturing equipment, and incorporate a significant part of technological progress. In this way they act as a powerful conveyor of technological innovations in the economy of a country.

While the technological contribution of MT has always been their major input into industrial development, with the accelerated technological progress in industry due to the incorporation of micro-electronics, particularly computerized numerical control (CNC) and the increasing utilization of computerized numerically controlled machine tools (CNCMT) as a basic instrument of flexible automation, the technological importance of this industry has grown even more.

In addition to its technological role, another crucial aspect of this industry which has made it particularly attractive in industrial development is the fact that MT manufacturers are, generally, medium-scale enterprises with relatively low investments in fixed assets employing highly qualified technical and production staff with much higher salaries than the industrial average.

Despite these attractions, the manufacture of MT is an activity undertaken by relatively few countries as we shall see in chapter II. In Latin America, only Argentina and Brazil have a long-standing tradition in this industry and despite the background of crisis against which it has had to develop, it has not only progressed considerably but has also generated an important flow of exports to the remainder of the region, particularly up to 1980.

In the case of Mexico, even though there has been production on a certain scale, the industry has had serious difficulties and demand has been satisfied mainly through imports. In Colombia there is limited local production while in other Andean countries there has never been any, or it was discontinued in the 1980s.

Outside Latin America, few developing countries have succeeded in making serious advances in this industry and in any event with somewhat unequal success. The most outstanding cases are those of Taiwan, South Korea and India. The People's Republic of China is also a significant producer, but at a less advanced technological level.

Among the industrialized countries, the case of Japan has certainly been the most spectacular with regard to the development of this industry and, while traditional producing countries such as the Federal Republic of Germany, Italy and Switzerland have been able to stand up to the dominance of Japan, other industrialized countries are encountering serious difficulties. Most prominent among these is the United States which has lost its importance in world production and exports and where imports have reached the point where they represent almost

half of apparent consumption. Despite a specific policy for the sector, France has not been able to cope with the new conditions in the industry either, and the United Kingdom has done so by recourse largely to direct investments by Japanese firms.

While the production of MT is concentrated in relatively few countries, international trade has been the main channel for international expansion in this industry. Exports as a proportion of world production rose progressively from 36 per cent in 1970 to 46 per cent in 1988. Furthermore, imports not only by non-producer countries but also by those very countries which manufacture these machines are becoming increasingly significant through the so-called intra-industrial trade.

While traditionally international trade has been the instrument of expansion of this industry, international transfer of technology has been growing in importance, and, to a lesser extent, so has direct foreign investment. Through licences for manufacture and transfer of product and process engineering, MT manufacturers have been able to reduce the technological gap separating them from firms which are on the frontiers of technical knowledge.

On the basis of these features of the industry at international level which will be described in chapter II, an examination will be made in chapter III of the demand for MT in Latin America through import statistics since, with the exception of Argentina and Brazil, the bulk of demand under this heading is met through imports.

The supply of MT manufacturered in Latin America will be studied in chapter IV with particular emphasis on the development and level of competitiveness of the industry in Argentina and Brazil. Opportunities for co-production of MT will be studied in chapter V, suggesting the financial, technological and organizational requirements involved in projects of that nature. In addition to the general discussion, there will be a separate study of opportunities for co-production between Argentine and Brazilian firms in the light of the stage of development achieved and in the context of the integration agreements already governing this branch, as well as of opportunities for co-production between Argentine and/or Brazilian enterprises with manufacturers in other countries of the region, particularly those with a certain level of development in the capital goods industry such as Mexico, Colombia and Venezuela.

As opportunities for co-production depend both on actual interest by enterprises and the formulation of specifically relevant trade, industrial and technological policies, this question will be examined in detail in chapter VI. The summary and conclusions of the work are set out in chapter VII.

II. THE INTERNATIONAL SITUATION

A. Structural features

MT 1/ are generally produced in relatively short runs and, in some exceptional cases, to the order of the user. Although production is standardized, MT are equipped with a variety of accessories which render the product quite heterogeneous.

This feature of MT manufacture means that economies of scale have had little impact on the traditional manufacture of these machines. Nevertheless, economies of scale are significant in the production of some components such as electric motors and have gained in importance in the manufacture of CNCMT, as we shall see below.

By contrast, economies of specialization are highly significant in this branch and are not only a feature of the production of complete MT but also a distinctive mark of the customary vertical deintegration of this industry in industrialized countries.

The production of MT is basically carried out by small and medium enterprises, although large firms are playing an increasing role in countries such as Japan and in countries which have recently entered the industry such as Brazil and South Korea.

In addition to manufacturers of complete MT, there are many manufacturers of parts and components which are generally highly specialized small and medium firms. These sub-contractors, unlike the situation in the motor industry, are frequently independent firms, in the sense that they provide parts and components to a number of manufacturers and even export a significant part of their production, resulting in intra-industrial trade relating not only to finished products but also to numerous parts and components.

MT manufacturers employ a high proportion of highly qualified technical workers and engineers and the production of these machines is an activity with extremely high added value. These qualified personnel, who used to come from

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1/ In this work we shall basically be referring to metalworking MT (which in trade statistics appear under the heading 84.45 of the BTN, 715.1 of the SITC Rev.1 or 736 of the SITC Rev.2), although in chapter III there will also be provided information available for 1987 on trade in woodworking MT (84.47 of the BTN) and on parts and components for metalworking MT (84.48 of the BTN).

Metalworking MT are divided into two major groups. Chip removing or cutting machine tools, and forming machine tools. Principal among the first are lathes, milling machines, boring machines, grinding machines, drilling or perforating machines and gear hobbing machines. Among the second are presses, shearing machines, wire drawing machines and machines for forging or stamping, rolling, bending, folding or planing.

Manual MT (pneumatic or with a non-electric motor) and welding machines are generally not included among metalworking MT. On the other hand, MT using electrospark erosion or other electrical processes are generally included.

mechanical engineering but increasingly include professionals in electronics, are the principal asset of MT manufacturers to the extent that they are the people who generate product innovations which are incorporated in the respective machines. In this industry formal research and development costs are not very high, although they have been increasing with the incorporation of electronics in MT.

The predominance of small and medium firms in the manufacture of MT and the absence of significant barriers to the entry of new producers into the field has given rise to a high level of competition, as regards both prices and performance, in domestic and international markets. However, barriers to the entry of new firms have been raised in the case of the manufacture of CNCMT, so that in this segment competition occurs more on the basis of performance than as a function of price.

Before turning to the technological and structural transformation which CNC has meant for this branch, it is important to consider some data relating to production and trade in the principal countries participating in the sector being studied.

B. Production and international trade

Table 1 lists the 36 principal MT-producing countries, based on the information provided annually (in the February issue) by the United States publication American Machinist. 2/

It is important to take account of some significant changes during the last 10 years in the international configuration of the MT industry. During those years world production reached a maximum value of $26,748 million in 1980, declining to only $19,530 million in 1983, recovering from then on, and reaching a record of $38,000 million in 1988 (based on information in current dollars contained in UCIMU, 1988 and table 1).

Firstly, Japan took over the top spot in world production in 1981 and, depending on the year, shared with Western Germany the first or second place as leader of world exports. For its part, Western Germany, which took over the leadership of world production in 1977 and 1978 and then lost its relative importance before the Japanese advance, succeeded in producing almost as much as Japan in 1987, although the latter moved ahead again in 1988 (table 1).

2/ Although the estimates for several countries are not very accurate and the conversion to United States dollars of local production suffers from all the problems inherent in exchange rate fluctuations and in some cases multiple exchange rates, this source is the most reliable in dealing with the subject and the only one providing data on production over many years. With regard to data on international trade, the other available source for world data is the statistics and estimates for imports and exports recorded by the United Nations, to which we had access with regard to the period 1980-1985 through information provided by UNCTAD to LATINEQUIP.

For information on international trade in MT for the ALADI/LAIA countries, we had excellent co-operation from the Statistical and Informatics Unit of INTAL, which made available its records for the years 1983 to 1987.

Secondly, the decline of the United States during the 1980s was quite dramatic. After losing the leadership in 1981, its relative share declined progressively and, in 1988, its production was overtaken by the third leading country in this branch, Italy. Production declined from a value of more than $5,000 million in 1981 to $2,000 million in 1983 (rising again to $2,400 million in 1988). The work-force employed fell from 108,000 in 1980 to 70,400 in 1986, and more than 300 of the 800 manufacturers have disappeared (Financial Times, 18 May 1987).

Thirdly, some socialist countries are important producers of MT but take little part in international trade.

Fourthly, among the major producer countries, although Italy and Switzerland have been able to resist the Japanese encroachment, and have even increased their participation in world production and export, this has not been the case with the United Kingdom and France, which have seen their role in this industry decline.

Finally, in addition to the rise of Japan, it should be noted that countries such as Spain, Yugoslavia, Taiwan and South Korea have significantly increased their share of world production and, with the exception of South Korea, world exports.

With regard to world exports of MT, from the maximum achieved in 1980, a year when there were exports to the value of $11,439 million, exports fell to a minimum of $8,400 million in 1983, recovering from then onwards to reach $17,328 million in 1988.

The export ratio (for all producer countries) increased from 36 per cent in 1970 to 42 per cent in 1978 and 46 per cent in 1988, which highlights the enormous importance of international trade in this industry. While Switzerland and Western Germany showed the highest export ratios among the principal producer countries, the Japanese ratio was under 40 per cent (table 1).

Imports as a percentage of apparent consumption in the producer countries themselves also grew significantly from 31 per cent in 1970 to 39 per cent in 1978 and 41 per cent in 1988. Nevertheless, as can be seen from table 1, the share of imports in apparent consumption varies greatly, with Japan being the country most closed to imports.

Although international trade continues to be the principal means of international expansion for MT manufacturers, in recent years the growing importance of direct foreign investment, a means of expansion little used in this branch, can be observed, together with an intensification of licence agreements.

Japanese manufacturers have established subsidiaries or joint ventures in the United States and some European countries to supply those markets. Japanese producers have also granted manufacturing licences to companies in other countries. In addition, North American and European firms have been active in transfer of technology agreements, joint ventures and direct investment (Haklisch & Vonortas, 1987).

The expansion of these activities has occurred in years where there has been relatively little growth in production and when the principal manufacturers have had to adjust themselves to the fundamental presence of Japan in exports and to the profound technological changes experienced in the branch.

Table 1

PRODUCTION AND WORLD TRADE IN MACHINE TOOLS IN 1988
(in millions of dollars and percentages)

Country	Production			Trade				
	Total	Cutting	Forming	Export	Import	Consumption	X/P	M/C
1. Japan	8 643.3	6 771.6	1 871.7	3 360.5	404.0	5 686.8	38.9	7.1
2. West Germany	6 833.3	4 863.0	1 970.3	4 128.5	1 138.9	3 843.7	60.4	29.6
3. Soviet Union*	4 500.0c	3 600.0c	900.0c	360.0c	1 850.0c	5 990.0	8.0	30.9
4. Italy	2 803.6	2 073.9	729.7	1 328.8	706.7	2 181.5	47.4	32.4
5. United States	2 440.0	1 565.0	875.0	602.2	2 012.0	3 849.8	24.7	52.3
6. Switzerland	1 913.6	1 667.6	246.0	1 626.6	403.2	690.2	85.0	58.4
7. East Germany*	1 457.0	1 170.7	286.3	1 298.4	285.0	443.6	89.1	64.2
8. England	1 349.3	1 183.4	166.0	667.7	737.8	1 419.4	49.5	52.0
9. France	805.8	639.7	166.1	335.7	906.5	1 376.6	41.7	65.9
10. People's Republic of China	731.6	532.1	199.5	130.0	550.0	1 151.6	17.8	47.8
11. Taiwan	695.2	533.7	161.6	421.6	316.3	589.9	60.6	53.6
12. Spain	673.6	510.6	163.0	249.7	302.9	726.8	37.1	41.7
13. Yugoslavia	671.7	498.3	173.3	445.5	171.9	398.1	66.3	43.2
14. Romania*	657.5	575.0	82.5	163.0	126.9	621.4	24.8	20.4
15. South Korea	597.1	473.5	123.7	48.0	560.0	1 109.1	8.0	50.5
16. Czechoslovakia*	450.0c	400.0c	50.0c	375.0c	95.0c	170.0	83.3	55.9
17. Brazil	448.9	368.1	80.8	35.9	40.0	453.0	8.0	8.8
18. Poland*	320.0c	265.0c	55.0c	100.0c	200.0c	420.0	31.3	47.6
19. Canada	290.0	173.9	116.3	94.1	748.6	944.5	32.4	79.3
20. Sweden	280.9	173.0	107.9	211.8	345.3	414.4	75.4	83.3
21. India	272.0c	160.0c	112.0c	34.0c	145.0c	383.0	12.5	37.9
22. Hungary	241.5	210.0	31.5	191.0	105.8	156.3	79.1	67.7
23. Belgium	190.0c	45.0c	145.0c	315.0c	345.0c	220.0	165.8	156.8
24. Austria	155.0c	120.0c	35.0c	169.0c	175.0c	161.0	109.0	108.7
25. Bulgaria*	150.0c	135.0c	15.0c	100.0c	350.0c	400.0	66.7	87.5
26. Israel	135.0c	100.0c	35.0c	115.0c	155.0c	175.0	85.2	88.6
27. Denmark	80.2	56.4	23.8	62.4	11.4	29.2	77.8	39.0
28. Australia	50.0c	20.0c	30.0c	5.0c	140.0c	185.0	10.0	75.7
29. Netherlands	45.5	30.3	15.2	179.5	343.8	209.8	394.5	163.9
30. Finland	42.7	6.3	36.4	39.9	111.3	114.1	93.4	97.5
31. Argentina	38.1	27.1	11.0	26.3	38.4	50.2	69.0	76.5
32. Singapore	37.0c	33.0c	4.0c	90.0c	150.0c	97.0	243.2	154.6
33. Portugal	19.2c	7.7c	11.5c	9.6c	34.0c	43.6	50.0	78.0
34. Mexico	18.0c	15.0c	3.0c	2 5c	240.0c	255.5	13.9	93.9
35. South Africa	9.7	5.3	4.4	0.2	88.0	97.5	2.1	90.3
36. Hong Kong	1.5c	0.2c	1.3c	6.5c	80.0u	75.0	433.3	106.7
TOTAL	38 047.4	29 009.4	9 038.2	17 328.0	14 513.7	35 233.1	45.5	41.2

Source: American Machinist.
c: estimate;
u: not revised;
*: Countries with controlled currency.

X: Exports;
P: Production;
M: Imports;
C: Consumption = M + P - X.

C. Technological transformation

While technological changes are inherent in the dynamics of the MT industry, since the middle of the 1970s technological advances have been accelerating as a result of progress in micro-electronics and now give rise to a convergence between mechanical and electronic engineering which the Japanese call mecatronics.

In the particular case of MT, the most visible expression of this trend is in numerical control, a technology which was invented in the 1950s in the United States and which, with the introduction of microcomputers in the control unit (CNC) in the mid-1970s, it has spread more rapidly and at the same time the dominant involvement of Japan started and gathered strength in this key segment of the branch being studied.

CNCMT spread rapidly in metal cutting MT (lathes, milling machines, grinding machines, etc.) and gave rise to a machine which combines several of them, so-called machining centres. CNC is also used in some metal-forming MTs, welding machines and robots.

In the case of Japan, 71 per cent of the manufactured value of metal cutting MT were NCMT in 1987 (NMTBA, 1988). In Western Germany and the United Kingdom the respective share was 50 per cent, in France 58 per cent and the United States 40 per cent in 1984 (according to the data from American Machinist, February 1986).

The growing spread of CNCMT is due to technological progress in the control unit, simplification of programming and the significant decrease in the prices of these machines, as well as policies followed in some countries to facilitate the acquisition of such machines by user enterprises (see Chudnovsky, 1986a for a detailed examination of the subject).

The reduction in prices and the increase in facilities for the utilization of CNCMT has permitted their spread to many small and medium users who previously were averse to the possibility of automating production in short runs. Nevertheless, it is important to bear in mind that the major investment implied by a CNCMT compared with a conventional machine requires an aggregate volume of production which makes it possible to amortize such a major investment in a reasonable time (Chudnovsky 1988b).

CNCMT are one of the key elements having a major economic impact within flexible automation. Compared with traditional automation in which specially constructed equipment is used to produce large volumes of relatively homogeneous goods such as motor vehicles, in flexible automation it is possible to obtain the same efficiency, with regard to the use of labour and level of quality, in the manufacture of relatively heterogeneous goods in small batches such as those customary in the metalworking industry, provided a high aggregate volume of production can be achieved.

While CNCMT are largely utilized as individual machines, the trend is towards integration with other elements of flexible automation such as robots and CAD/CAM (computer-aided design and manufacture) systems in order to achieve systems gains.

Manufacturers of MT are not only increasingly oriented towards producing CNCMT, but also so-called manufacturing systems which range from flexible modules to true integrated centres for computerized manufacture.

The transformation of the engineering industry into mecatronics has fundamental consequences for the MT industry, which are beginning to be seen and which will be a feature of the evolution of the branch in the 1990s.

The design and production of CNCMT continues to be an activity making intensive use of highly qualified personnel, although with a growing participation of electronics and computer professionals, even when the electronic components and equipment are obtained from specialist firms. Artisans are becoming increasingly less involved in the design process, which requires CAD systems and software engineering tools. The production process requires fewer qualified personnel than in the case of conventional MT, thus reducing the relative proportion of skilled operators. At the same time, it implies the use of more costly equipment and machinery, basically CNCMT, particularly in machining centres.

While CNCMT continue to be produced in short runs, factories require a higher production volume than in the case of the manufacture of conventional MT, in order to amortize the greater investment cost of this equipment and the more significant design, research and development costs of products. It is thus not surprising that the manufacture of CNCMT is a more concentrated activity than the production of conventional MT and that the barriers to entry of new firms are greater (Jacobsson, 1986).

Although the majority of CNCMT manufacturers in the industrialized countries rely on specialist suppliers to obtain the control unit and other electronic equipment, those firms which produce very sophisticated CNCMT or which are oriented towards the integration of manufacturing systems have integrated themselves upstream and manufacture the automatic components themselves, even though these are sometimes more expensive than when they are acquired from specialist suppliers.

Over and above the particular form which CNCMT manufacturers have selected to make use of electronic technology, enabling them to produce increasingly efficient and economical CNCMT, the trend towards mecatronics in the development and production of MT appears to be strengthening in industrialized countries. This trend is changing some of the structural parameters of the branch and will probably not only make entry more difficult but will also make it more difficult for those firms to stay in which do not update their design and production technology on a continuous basis in order to match up to the requirements of users in an evermore demanding and competitive world market.

III. IMPORTS TO LATIN AMERICA

A. Recent developments

Given that only Argentina and Brazil have a significant MT production, the import statistics provide a good approximation of demand in the region.

As can be seen in table 2, imports into the region, after reaching a maximum value of almost $900 million in 1981, fell sharply, so that in 1985 they were only a third of what they had been in 1981.

The decline in imports of MT has not only been more marked than that for total imports but has also been greater than the decline in imports of capital goods, which were 40 per cent less in 1985 than in 1981.

This decline in the demand for MT highlights not only the general magnitude of the adjustment but the drastic fall in productive investment suffered by the region during that period.

Furthermore, while world imports also fell between 1980 and 1983, they did so to a much lesser extent than in Latin America (table 2). Consequently, Latin America's share of world imports of MT fell from 9.6 per cent in 1981 to 3.8 per cent in 1985.

While world imports began to recover in 1985 and according to the estimates of American Machinist have been significantly increasing since then, imports by member countries of ALADI/LAIA grew to some extent in 1986 and 1987. However, in the latter year they still did not amount to half of what they were in 1981 in current dollars.

As can be seen in table 2, imports into Latin America are concentrated in a few countries. 3/ Mexico alone represents almost half of total imports and is followed by Brazil. Venezuela has displaced Argentina as the third market in importance since 1982. Colombia is also a significant importer. At the beginning of the decade, Chile, Ecuador and Peru were importing MT to a value of more than $10 million per year. In the remaining countries annual imports were very small, even before the crisis, reflecting the lack of development there of a metal-engineering industry which is the main source of demand for MT.

In the context of a general reduction in MT imports as from 1980 or 1981, there can be noted a degree of recovery in Brazil, Venezuela and Peru in 1986 and 1987, and in Argentina, Colombia, Peru and Chile in 1987. On the other hand, in 1987 Mexican imports declined again.

Over and above fluctuations in the economic situation, it is clear that demand for MT in Latin America has contracted significantly as a result of the current low level of investment in production. Nevertheless, the amounts imported by some countries highlight the fact that there is a significant demand which could give rise to a greater local production than actually occurs.

B. The principal sources

The market economy industrialized countries are almost the exclusive suppliers of the MT demanded in Latin America (tables 3 and 4).

In table 4 it can be seen that, although with large variations, the share of the United States is very significant and up to 1986 increased progressively to 42.6 per cent of the total imported by ALADI/LAIA countries.

It is worth noting that the share of the United States in Latin American imports is eight to ten times greater than its share in world exports (which was 4.8 per cent in 1983, declining to 4.3 per cent in 1987 (UCIMU, 1988)). At the same time, as we shall point out, the North American MT industry is going through a serious crisis of competitiveness, which means that Latin America is dependent on a supplier which is declining internationally.

3/ We have only considered countries importing machines to a value of a million dollars or more in 1980.

Table 2

IMPORTS OF MACHINE TOOLS

(in millions of dollars)

Countries	1980	1981	1982	1983	1984	1985	1986	1987
Scenario 1	9 633.0	9 328.0	8 180.0	6 930.0	7 090.0	7 994.0	n.d.	n.d.
2	9 662.0	9 665.0	8 072.0	6 766.0	7 012.0	8 758.0	10 727.0	13 010.0
Latin America	882.0	892.0	675.0	339.0	326.0	306.0	n.d.	n.d.
ALADI/LAIA	859.3	869.2	628.0	322.8	311.2	280.9	345.6	410.7
Mexico	406.2	508.2	382.7	189.6	178.2	148.1	177.2	126.4
Brazil	209.3	136.1	92.3	64.8	43.3	36.3	60.6	120.1
Argentina	82.2	70.2	39.2	20.6	22.6	31.4	16.4	38.3
Venezuela	68.4	60.2	49.5	18.3	33.4	41.8	54.7	68.1
Colombia	30.2	31.3	23.5	17.8	19.6	10.1	11.6	19.1
Chile	16.2	18.4	9.1	1.6	4.9	4.2	6.6	14.7
Ecuador	14.4	13.0	10.0	3.0	4.4	3.6	8.5	8.9
Peru	13.5	16.3	17.4	5.2	2.8	3.4	6.4	8.1
Uruguay	9.9	6.2	2.1	0.8	0.2	0.7	0.5	1.5
Trinidad and Tobago	7.2	4.8	22.9	5.3	1.0	1.1	1.2	1.5
Bolivia	6.6	6.4	1.1	0.8	1.6	0.8	1.7	3.0
Paraguay	2.4	2.9	1.1	0.3	0.2	0.5	n.d.	n.d.
Cuba	1.8	5.9	9.1	1.6	2.8	12.4	n.d.	n.d.
Dominican Republic	1.6	1.3	1.2	0.5	0.7	2.2	n.d.	n.d.
Costa Rica	1.4	0.4	1.1	1.8	2.7	2.4	n.d.	n.d.
Honduras	1.3	0.6	0.6	0.3	1.3	1.4	n.d.	n.d.
Guatemala	1.1	1.4	1.6	0.9	1.5	1.2	n.d.	n.d.
El Salvador	1.0	0.2	0.6	0.6	0.6	0.6	n.d.	n.d.
Barbados	1.0	1.0	0.7	0.2	0.2	0.5	n.d.	n.d.

Source: Latinequip based on data provided by UNCTAD (SITC Rev.1 715.1) for the years 1980-1985 included in scenario 1; American Machinist for scenario 2; INTAL (BTN 84.45) for 1986-1987.

Table 3

PRINCIPAL SUPPLIERS OF MACHINE TOOLS
(millions of dollars)

Imports/year		World	USA	FRG	Italy	Japan	Switzerland	Spain	Argentina	Brazil
Mexico	1983	170.8	39.6	20.1	5.4	9.3	1.0	7.6	0.2	0.6
	1984	178.2	55.6	18.1	1.9	18.4	3.5	4.4	0.4	2.2
	1985	149.7	63.4	22.0	4.8	30.3	5.3	7.8	0.8	2.1
	1986	177.2	114.8	23.9	5.2	1.4	3.0	6.3	0.4	0.8
	1987	126.4	78.1	23.3	4.7	6.7	4.3	1.9	0.1	0.6
Brazil	1983	65.6	18.5	17.7	6.5	13.8	2.8	0.4	0.0	0.0
	1984	42.2	13.3	7.0	16.3	2.7	1.0	0.3	0.1	0.0
	1985	36.3	9.7	15.1	1.9	2.8	2.7	0.3	0.2	0.0
	1986	60.6	9.8	23.7	5.4	9.0	6.1	0.4	0.7	0.0
	1987	120.1	18.7	40.9	13.3	13.6	5.8	2.5	11.4	0.0
Venezuela	1983	25.4	7.8	2.7	7.6	1.0	0.1	3.3	0.1	0.3
	1984	33.5	6.5	6.6	6.3	0.7	0.0	3.5	0.1	2.4
	1985	41.9	12.1	5.5	8.8	2.1	0.5	4.6	0.1	1.0
	1986	54.7	13.6	8.1	7.8	2.2	1.0	4.2	0.2	0.9
	1987	68.1	19.4	6.4	15.6	3.2	0.4	4.5	0.2	0.4
Argentina	1983	20.6	3.7	3.4	3.0	3.5	1.1	0.1	0.0	1.4
	1984	22.6	4.7	5.8	2.2	4.8	0.5	1.3	0.0	0.6
	1985	31.4	6.8	7.0	6.0	3.4	1.7	1.0	0.0	1.1
	1986	16.4	2.3	6.2	3.1	1.7	0.2	0.7	0.0	0.7
	1987	38.3	2.3	8.6	4.7	1.5	4.6	1.6	0.0	1.9
Colombia	1983	18.1	5.5	1.4	1.8	0.5	0.2	3.3	0.3	0.3
	1984	19.7	9.6	1.6	1.1	0.1	0.2	2.3	0.2	0.2
	1985	11.4	5.4	0.8	0.4	1.3	0.2	1.1	0.9	0.2
	1986	11.6	2.2	1.3	1.2	0.1	0.6	2.0	0.3	0.1
	1987	19.9	4.7	2.8	2.1	0.3	1.2	2.7	0.3	0.6
Peru	1983	7.4	0.5	1.3	1.7	1.8	1.8	0.3	1.4	0.5
	1984	2.8	0.8	0.4	0.3	0.0	0.0	0.1	0.1	0.1
	1985	3.4	0.5	0.4	0.5	0.0	0.0	0.1	0.1	0.1
	1986	6.5	2.4	0.3	0.7	0.7	0.0	0.6	0.1	0.1
	1987	8.1	1.1	1.4	1.2	0.3	0.0	0.7	1.4	0.4
Ecuador	1983	7.8	1.3	0.3	0.5	0.1	0.0	0.4	0.1	0.2
	1984	4.4	0.5	0.0	0.8	0.0	0.7	1.0	0.1	0.1
	1985	10.3	0.9	0.6	0.7	0.0	0.1	1.0	0.2	0.4
	1986	8.5	1.0	1.3	0.9	0.0	0.1	0.8	0.0	0.2
	1987	8.9	2.0	1.2	1.9	0.1	0.0	1.2	0.0	0.0
ALADI/LAIA	1983	321.1	78.3	47.6	27.0	28.5	5.6	15.6	2.7	3.8
	1984	310.2	93.2	40.1	29.8	26.8	6.1	13.2	1.4	6.4
	1985	290.7	99.7	52.8	23.9	40.1	10.7	16.5	1.9	5.4
	1986	345.6	147.2	66.2	25.8	26.3	11.3	15.3	2.8	5.3
	1987	410.7	128.7	86.0	46.0	25.9	17.0	16.0	14.8	7.2

Source: INTAL.

Table 4

PRINCIPAL SUPPLIERS OF MACHINE TOOLS
(percentages)

Imports/year		USA	FRG	Italy	Japan	Switzerland	Spain	Argentina	Brazil
Mexico	1983	23.2	11.8	3.2	5.4	0.6	4.4	0.1	0.4
	1984	31.2	10.2	1.1	10.3	2.0	2.5	0.2	1.2
	1985	42.4	14.7	3.2	20.2	3.5	5.2	0.5	1.4
	1986	64.8	13.5	2.9	0.8	1.7	3.6	0.2	0.5
	1987	61.8	18.4	3.7	5.3	3.4	1.5	0.0	0.5
Brazil	1983	28.2	27.0	9.9	21.0	4.3	0.6	0.0	0.0
	1984	31.5	16.6	38.6	6.4	2.4	0.7	0.2	0.0
	1985	26.7	41.5	5.2	7.7	7.4	0.8	0.6	0.0
	1986	16.2	39.1	8.9	14.8	10.1	0.6	1.2	0.0
	1987	15.6	34.1	11.1	11.3	4.8	2.1	9.5	0.0
Venezuela	1983	30.7	10.6	29.9	3.9	0.4	13.0	0.4	1.2
	1984	19.4	19.7	18.8	2.1	0.1	10.4	0.2	7.1
	1985	28.9	13.1	21.0	5.0	1.2	11.0	0.2	2.3
	1986	24.9	14.7	14.3	4.0	1.8	7.7	0.3	1.6
	1987	28.5	9.4	22.9	4.7	0.6	6.6	0.3	0.6
Argentina	1983	18.0	16.5	14.6	17.0	5.3	0.5	0.0	6.8
	1984	20.8	25.7	9.7	21.2	2.2	5.7	0.0	2.7
	1985	21.7	22.3	19.1	10.8	5.4	3.2	0.0	3.5
	1986	14.0	37.8	18.8	10.4	1.2	4.2	0.0	4.3
	1987	6.0	22.5	12.4	3.9	12.0	4.2	0.0	5.0
Colombia	1983	30.4	7.7	9.9	2.8	1.1	18.2	1.7	1.7
	1984	48.7	8.1	5.6	0.4	1.0	11.7	1.0	1.0
	1985	47.4	7.0	3.5	11.4	1.8	9.6	7.7	1.4
	1986	19.0	11.2	10.3	0.5	5.2	17.2	2.6	0.9
	1987	23.6	14.1	10.6	1.5	6.0	13.6	1.5	3.0
Peru	1983	6.8	17.6	23.0	24.3	24.3	4.1	18.9	6.8
	1984	28.6	14.3	10.7	1.4	0.1	3.6	3.6	2.5
	1985	14.7	11.8	14.7	1.1	0.7	2.9	2.0	1.9
	1986	36.9	4.6	10.8	10.8	0.0	9.2	1.5	0.9
	1987	13.6	17.3	14.8	3.7	0.0	8.6	17.3	4.9
Ecuador	1983	16.7	3.8	6.4	1.3	0.5	5.1	1.3	2.6
	1984	11.4	0.2	18.2	0.0	15.9	22.7	2.2	2.3
	1985	8.7	5.8	6.8	0.4	0.6	9.7	1.7	3.5
	1986	11.2	15.3	10.4	0.4	1.2	9.4	0.6	1.8
	1987	22.5	13.5	21.3	1.0	0.0	13.5	0.0	0.0
ALADI/LAIA	1983	24.4	14.8	8.4	8.9	1.7	4.9	0.8	1.2
	1984	30.0	12.9	9.6	8.6	2.0	4.2	0.5	2.1
	1985	34.3	18.2	8.2	13.8	3.7	5.7	0.7	1.9
	1986	42.6	19.2	7.5	7.6	3.3	4.4	0.8	1.5
	1987	31.3	20.9	11.2	6.3	4.1	3.9	3.6	1.8

Source: INTAL.

The dominant role held by the United States as a supplier has meant that leading countries such as Western Germany, Switzerland and particularly Japan have a much smaller share in the region than in the world (in 1987, for example, Western Germany, Japan and Switzerland accounted for 23.9, 20.3 and 9.1 per cent respectively of world exports (UCIMU, 1988)). On the other hand, the share of Italy in ALADI/LAIA imports is somewhat greater than in world exports and Spain's is significantly greater.

The above-mentioned shares are greatly influenced by the enormous preponderance of the United States as a supplier of MT to Mexico. In the Argentine and Brazilian markets Western Germany, not the United States, is the main supplier. Japan has had a significant share in the imports of both countries in some years and Italy is a very important supplier to Argentina, although its significance has declined since 1985.

In Venezuela and Colombia, while the United States is the largest supplier country, Italy and Spain have a substantial share, as can be seen in table 4.

With regard to imports from Latin American suppliers, while there are some small transactions originating in Colombia (directed towards Ecuador, Peru and Venezuela) and in Mexico, the bulk of the trade comes from Argentina and Brazil.

Whereas in 1980 Argentina and Brazil accounted for 9.3 per cent of imports, that share declined to only 2.3 per cent in 1986. With the integration agreement implemented between Argentina and Brazil, reciprocal trade increased in 1987.

The Mexican market, which was the main one in Latin America for Argentina and Brazil in 1980, collapsed with the crisis. Imports from Brazil fell from 10.3 per cent in 1980 to insignificant levels as can be seen in table 4. 4/ Something similar occurred with imports from Argentina, which represented 3.2 per cent of the total imported by Mexico in 1980.

With limited amounts of trade and many annual variations, imports from Brazil had a certain significance in Argentina, Venezuela and Peru in the period 1983-1987.

Imports from Argentina to Peru were considerable in 1983 and 1987, and to Colombia they were also of some significance. However, it was the opening up of the Brazilian market which permitted a substantial increase in the Argentine share in 1987.

It is clear that in the context of reduced demand for MT experienced in the region since 1982, the low level of intraregional trade has been affected to an even greater extent than trade with suppliers outside the region, with the exception of the situation in 1987 following the trade agreement between Argentina and Brazil.

C. Composition by principal machine tools

In order to have a more precise idea of the opportunities for setting up co-production projects it would be desirable to have information on existing demand on the principal markets of the region by type of MT or even better by technological complexity, if possible distinguishing between complete MT and the principal parts and components.

4/ However, see note 8 on page 23.

Regrettably the form in which the import registers are drawn up make this task impossible. The eight digit trade figures provided by countries to INTAL only give a very general idea of the composition of imports by principal products and the total amount of parts and components imported.

As can be seen in table 5, in the case of Mexico the existing breakdown is so deficient that it is only possible to distinguish six general types of lathe (which unfortunately do not include a specific item relating to numerical control) and only two other types of MT, grinding and polishing machines and sharpening machines. The remaining MT are included under the heading "unclassified".

With such tenuous data, there is little to be said except to note the surprising preponderance (64 per cent of imported value in 1987 and 50 per cent in 1986) of lathes in Mexican imports. With regard to parts and components, imports are significant, representing a quarter of the imported value of complete MT.

The composition of imports in the Andean countries set out in table 6 highlights a relatively diversified demand, including a large incidence of chip-removing MT such as milling machines and various types of lathe. Within imports of lathes, while in Venezuela automatic lathes and other lathes (which generally include the most technologically advanced) are predominant, in Peru, Colombia and Ecuador centre lathes are those that occur most frequently in imports.

In addition to milling machines which are the main MT imported by Venezuela and Colombia, grinding machines are fairly important in Venezuela, Ecuador and Colombia, and hydraulic and other presses in Venezuela. Forming MT, particularly wire-drawing machines, are significant categories in imports to Venezuela, Colombia and Ecuador while saws are items of some significance in Ecuador, and, to a lesser extent, in Venezuela.

The parts and spares for MT and woodworking MT are significant items in Venezuelan imports.

With regard to the composition of Brazilian imports (table 5), within a range of imported categories the importance of grinding machines, milling machines, stamping machines and gear hobbing machines stands out along with some forming MT.

In the import registers, machining centres only appear included in CNCMT, but as will be seen below there are more imports under this heading.

The enormous significance of imports of parts and spares for MT in Brazil is striking given the high level of vertical integration of the MT industry in that country.

Given the form in which MT imports are classified in Argentina (a very wide nomenclature is utilized with many imports under the heading "other") there is little that can be said about their composition. As can be seen in table 5, "saws, other" and bending machines appear to be the most common category. CNCMT which, unlike in other countries are indeed identified in the nomenclature, have been of some importance in the respective imports.

Table 5

COMPOSITION OF IMPORTS OF MT IN 1987

(in thousands of dollars)

Argentina		Brazil		Mexico	
Saws, other	8 913	Grinding machines, other	17 850	Copying swing lathes	22 738
Bending machines	3 061	Other forming MT	9 095	Lathes	20 874
Valve grinders	2 271	Stamping machines	7 702	Centre lathes	12 911
Wire forming machines, other	1 979	Vertical milling machines	6 932	Vertical lathes	7 459
Gear hobbing machines, other	1 581	Other milling machines	5 839	Semi automatic turret lathes	5 286
Other	1 252	Other cutting MT	5 779	Automatic lathes	4 700
Rasping machines, other	1 193	Automatic lathes over 300 kg	5 661	Grinders and polishers	16 353
CNC lathes	1 192	Gear hobbing machines	5 365	Sharpening machines	10 277
CNC lathes, other	970	Machining centres	5 196	Unclassified	19 064
CNC milling machines	939	Bending machines	4 270		
Punches, other	1 025	Electrospark erosion machines	4 051		
		Horizontal grinding machines	2 461		
		Other shearers	2 032		
		Transfer machines	1 844		
		Other boring machines	1 711		
		Forging machines	1 710		
Imported total (BTN 84.45)	38 335		120 115		126 413
Parts for machine tools (BTN 84.48)	8 106		45 932		31 744
Woodworking MT	3 189		7 942		9 155

Source: INTAL.

Table 6

COMPOSITION OF PRINCIPAL IMPORTS OF ANDEAN COUNTRIES IN 1987

(in thousands of dollars)

	Venezuela	Colombia	Peru	Ecuador	Bolivia
Turret lathes	846	465	299	118	-
Centre lathes	2 947	1 770	1 194	1 058	80
Vertical lathes	925	124	80	20	-
Automatic lathes	8 617	939	171	281	-
Other lathes	3 747	214	-	-	159
Other drilling machines	2 399	584	212	-	10
Milling machines	9 042	3 315	555	654	52
Saws	2 138	411	47	1 270	12
Grinding machines	5 370	1 402	765	1 311	313
Other grinding machines	2 383	1 303	426	603	134
Hydraulic presses	2 415	654	730	72	10
Other presses	6 861	554	768	515	20
Wire-drawing machines	1 121	587	334	549	108
Other wire-drawing machines	2 699	1 255	103	517	369
Shearing machines	1 647	692	686	352	80
Bending machines	1 091	840	395	914	45
Broaching machines	1 124	564	245	146	28
Electrospark erosion machines	905	820	110	-	-
Other	10 144	2 376	441	-	19
Total imported (BTN 84.45)	68 153	19 902	8 123	8 894	1 499
Parts for MT (BTN 84.48)	21 161	2 501	1 877	1 572	328
Woodworking MT	5 793	1 618	1 810	1 446	743

Source: INTAL.

IV. PRODUCTION IN LATIN AMERICA

A. The industry in Argentina 5/

Although there are earlier examples recorded, the manufacture of MT in Argentina originated in the import difficulties which the country experienced during the Second World War. During those years a series of artisanal workshops were established which evolved from the repair of imported machines to the production of relatively simple general-purpose machines. These workshops, set up by immigrants, usually of Italian origin, or based on the apprenticeship of skilled operators, grew with the development of this industry and, in some cases, were the origin of firms which are now leaders in the manufacture of MT in the country.

As a result of the demand for MT experienced by the metal-engineering industry and particularly the motor industry, the industry reached its apogee during the first half of the 1970s and in 1973 produced 22,500 units, the maximum achieved in terms of volume of manufacture. In the census of 1974, the metalworking and woodworking MT manufacturing branch had 344 establishments and employed 5,860 people, including six firms with more than 100 employees.

It was an industry dominated by small and medium establishments, mainly with national capital, which hardly ever relied on manufacturing licences but rather on imitating foreign models.

While the basic instrument for promoting MT production was the tariff barrier which covered imported products, effective protection of locally manufactured MT was in fact low. Thus studies carried out in 1977 reveal that MT had a nominal protection of 25 per cent and an effective protection of 10 per cent.

In addition to satisfying some 60 per cent of apparent consumption, the industry in Argentina began to generate important export flows from 1974 onwards (the year in which exports amounted to $6.7 million) reaching a maximum of $27.3 million in 1980. Exports were almost wholly directed to Latin America and concentrated on relatively simple machines, of a general-purpose type which were easy to handle and which could compete adequately in type and quality with those coming from other sources. That type of machine was not manufactured in the region, except in Brazil. Exporting to Latin America in that year of market growth and sheltered by the LAFTA agreements did not require major technological and marketing efforts, although it evidenced a level of specialization in the Argentine industry which made it competitive in the Latin American market (Campos, 1977).

The economic policies followed in Argentina as from 1976, and particularly in the period 1979-1981, together with the profound crisis which enveloped the economy in the 1980s, fundamentally affected the manufacturing industry, including MT production.

The decline in output began slowly in 1978 and accelerated from 1981 onwards. The year 1985 saw the lowest level of production recorded in the history of the MT industry in Argentina.

5/ In addition to the works of other authors cited in the text, we used our own studies: Chudnovsky 1985; Chudnovsky 1986; Chudnovsky and Groisman 1987; Chudnovsky 1986.

Under the open door policy in the 1979-1981 period which apart from the lowering of tariff barriers was characterized by an over-valuation of the national currency favouring imports, although production could be sustained at the start thanks to the competitive efforts of certain firms and the export drive, it could not resist the collapse of the internal market and the reduction in international trade betwen 1981 and 1983, or the problems arising in the Latin American market following the debt crisis in 1982.

The shrinking of output resulted in the disappearance of many establishments, others turned to repair or other categories of work, and the number of staff employed by those continuing to manufacture MT fell.

The only bright spot in this desolate panorama was the introduction of CNC lathes which were produced in small quantities as from 1979 and which, as from 1984, were manufactured under licence from a Japanese firm. In addition to the pioneer firm, another Argentine enterprise specializing in the manufacture of transfer machines entered the manufacture of machining centres and CNC lathes in 1985 without the use of licence agreements. In 1986 CNC milling machines were launched on the market by another major Argentine firm. In all cases, the CNC units were imported and the country produced the mechanical part of the CNCMT (representing between 70 and 80 per cent of the total value).

The crisis through which the industry passed not only reduced its size but also increased the technological diversity of the manufacturers. While the general situation concerning process engineering and equipment matched the depressed levels of production at which the majority of MT manufacturers were operating, some firms tried to remain not too far behind the international vanguard by making efforts in product engineering, as occurred with CNCMT which undoubtedly was the most dynamic segment of the branch.

Even within the low levels of manufacturing investment in the Argentine industry from 1982, there was a degree of investment recovery in 1986 and 1987 which led to increased demand for MT. In that connection, the provision of some credit lines by the National Development Bank for the purchase of machinery and equipment also favoured the local production of MT, which grew significantly in 1986 and 1987, and in particular there was a change in the composition and target of manufacture.

Before analysing these changes, it is very important to bear in mind that from 1987 onwards the majority of MT were included in the common list of Protocol No. 1 on capital goods of the economic co-operation and integration programme between Argentina and Brazil. There is a zero tariff on machines included in the Protocol and trade in them is not subject to tariff restrictions. However, due to the existing reserved market in Brazil for CNC units, CNCMT were exported without the control unit which was installed directly in Brazil or with a Brazilian control unit (which was imported into Argentina and re-exported to Brazil incorporated in the CNCMT).

In addition to the integration treaty with Brazil, the preferential credits granted by Italy and to a lesser extent by Spain for the import of capital goods from those countries and the agreement signed between Argentina and Italy to promote investment and joint enterprises are other important elements to be taken into account in analysing the sector under study.

The treaty with Italy, which has not yet been implemented, set up several joint enterprise initiatives between Argentine and Italian manufacturers. The most significant is the project for installing a new factory making machining centres

with technology and capital investment by a large Italian manufacturer in partnership with the principal manufacturer of numerically controlled lathes in Argentina (Del Bello, 1989).

The opening of the Brazilian market to MT produced in Argentina has been a measure of the fundamental importance for development of this branch since it enabled it to generate a very significant flow of exports.

As can be seen in table 7 exports of MT, which after reaching a low of $3 million in 1984 increased to $4.7 million in 1986, rose to $16 million in 1987 and a historical maximum in 1988 ($32.6 million). 6/

Exports which represented only 14.2 per cent of production in 1986 rose to 40 per cent in 1987 and 67 per cent in 1988 (table 7). This increase in the export ratio also reflects the brutal contraction of domestic demand recorded in Argentina since 1987 and especially in 1988.

Among the members of ALADI/LAIA, to which Argentina directs almost all its exports, Brazil became the main target. While in 1986 Brazil absorbed 11.7 per cent of the total exported, in 1987 the figure rose to 70 per cent and in the first nine months of 1989 to 74 per cent. To a much lesser extent than Brazil, Peru, Chile, Bolivia and Uruguay were the other important destinations for Argentine exports. As can be seen from tables 3 and 4, in Mexico, Venezuela and Colombia the presence of Argentine MT has been marginal in recent years.

With regard to the composition of production, the most notable fact is the growing signficance of CNCMT in the total manufactured and exported. These machines, which represented 7 per cent of manufactured value in 1985, rose to 28.4 per cent in 1988. CNC lathes rose from 16 per cent to 58 per cent of the manufactured value of lathes in the same period.

The change in the pattern of production explains the great increase in productivity recorded in the sector. Thus production per man employed in the sector doubled between 1985 and 1988 (table 7).

With regard to exports, CNC lathes became the main item in 1987 and 1988. In the latter year Brazil absorbed 65 of the 77 machines exported (and 93 per cent of the value exported) by Argentina. Chile was the second most important market for CNC lathes.

In addition to CNC lathes, automatic and centre lathes, milling machines, eccentric presses and grinding machines are the principal categories of Argentine MT exports. With the exception of grinding machines, the Brazilian market absorbed between two thirds and three quarters of the total value of all the other MT exported.

Imports of MT which as we saw in the preceding chapter had declined to very low levels recovered to some extent in 1987 and 1988 and represented a very significant proportion of apparent consumption (table 7).

6/ With regard to statistical information on Argentina we wish to express our gratitude for the excellent collaboration provided by the Economics Department of the Argentine Association of Machine Tool Manufacturers (AAFMHA).

Table 7

PRODUCTION, EXPORT AND IMPORT OF METALWORKING MACHINE TOOLS IN ARGENTINA

(in thousands of dollars and units)

		1985	1986	1987	1988
Production					
ESTIMATED	v	19 849	33 053	39 927	48 623
(total)	u	3 362	4 410	5 360	5 639
AAFMHA	v	18 364	30 960	34 180	420
(total)	u	2 593	4 170	4 446	2 763
CONV. LATHES	v	6 355	6 212	5 040	8 035
(only)	u	555	766	738	673
CNCMT	v	1 267	3 351	10 208	11 934
(total)	u	15	34	100	96
CNC LATHES	v	1 204	2 679	9 597	11 181
(only)	u	13	29	94	90
CNCMT/TOT. PROD. %	v	6.9	10.8	29.9	28.4
CNC LATHES/TOT. LATHES %		15.9	30.1	65.6	58.2
EXPORTS					
(TOTAL)	v	3 706	4 711	15 988	32 590
	u	1 180	627	2 171	3 818
EXP/PROD. %	v	18.7	14.3	40.0	67.0
CNC LATHES	v	50	260	3 954	9 594
(only)	u	1	5	38	77
X/P CNC LATHES %	v	4.2	9.7	41.2	85.8
IMPORTS					
(TOTAL)	v	31 314	16 425	38 337	44 648
	u	3 413	1 215	1 239	1 229
CNCMT	v	4 226	3 885	4 601	9 014
(only)	u	28	33	31	40
CONSUMPTION					
TOTAL	v	47 457	44 767	62 276	60 681
	u	5 595	4 998	4 428	3 050
CNCMT	v	5 443	6 976	10 855	11 354
	u	42	62	93	59
IMP/CONS. %	v	66.0	36.7	61.6	73.6
	u	61.0	24.3	28.0	40.3
IMP/CONS. CNC %	v	77.6	55.7	42.4	79.4
	u	66.7	53.2	33.3	67.8
NUMBER OF EMPLOYEES		1 567	1 701	1 856	1 870
PROD./EMPLOYEE	v	11.7	18.2	18.4	22.5

Note: Estimated production based on production of members of the AAFMHA and export data from INDEC. Value = v; Units = u.

Source: Own preparation based on data from the Economics Department of the Argentine Association of Manufacturers of Machine Tools (AAFMHA) and INDEC.

The recovery which can be observed in the MT industry in recent years has emphasized the technological diversity of the sector. On the one hand, there are around 10 firms (including component manufacturers) of a good technological level and with leading positions in manufacture and export. On the other hand, there are numerous smaller firms which produce simpler MT, some of which are exported but which in general are not technologically up to date.

Among the enterprises of major technological and commercial scale can be found the two manufacturers of CNCMT which we mentioned as specializing in lathes and machining centres, with greater experience accumulated in respect of lathes. Three smaller firms are also advancing in the production of milling machines and CNC lathes, one of them also manufacturing special custom-made machines. Also among the better developed firms are manufacturers of eccentric presses, folders and guillotines and welding machines as well as hydraulic and pneumatic automation components.

All the firms mentioned have made significant exports to Latin America and some of them are responsible for the export boom to Brazil. Moreover, one of the leading firms already has a subsidiary in São Paulo producing transfer machines and has set up a small firm in Venezuela to produce accessories. It also attempted to install an enterprise in Mexico to create a mixed firm with a major local enterprise but this did not come to fruition.

In order to examine in the next chapter the possible advantages and disadvantages that Argentine firms have as potential partners in establishing co-production both in Brazil and in other countries of the region, it is important clearly to state their strong and weak points in relation to international competition.

In products such as MT in which not only prices but also performance and numerous accessories are involved, it is almost impossible to make sound comparisons of manufacturing competitiveness. In addition to this difficulty, the wide fluctuations recorded by the real rate of exchange in Argentina and the significant variations registered between the dollar and the currencies of other countries manufacturing MT complicate the task to an extraordinary degree.

Despite these difficulties, in a study which we carried out in 1987 it was shown that, with the exception of CNCMT, MT manufactured in Argentina could without major problems compete in price with the products of the industrialized countries but were at a disadvantage compared with machines coming from South Korea and Taiwan (Chudnovsky and Groisman, 1987).

The reasons for this competitiveness were low labour costs (an item involving between 20 and 35 per cent of total costs) and the fact that casting (an item accounting for between 10 and 20 per cent according to the type of MT) had a standard international price tag. On the other hand, metallurgical inputs (which are only really significant in some forming MT) were much more expensive than international ones, as were electric motors.

CNCMT, despite the import of the motors and all the electronics (items which account for between 20 and 33 per cent of the total costs), were much more expensive than those produced abroad. The main reason for the lack of competitiveness on price was the low level of production. It is probable that with the significant increase in the level of production, CNC lathes produced in Argentina have become much more competitive than in 1987. An indicator in this sense is the good penetration by these CNCMT in the Brazilian market (despite the

fact that they are sold there with a control unit produced in Brazil which is much more expensive than ones imported from Germany or Japan) and above all in the Chilean market where the competition from third countries is strong.

Apart from the depressed internal market, the greatest weakness of Argentine manufacturers is the gap between them and the international elite. Despite the efforts to catch up in product engineering, CNCMT are five to 10 years behind what is being manufactured in Japan or in Western Europe. Moreover, in process engineering the significant efforts which some Argentine firms made in the 1970s (see Castaño, Ketz, Navajas, 1981) were discontinued with the crisis and have only very recently been implemented.

This weakness in product and process engineering could be compensated by an asset which Argentine manufacturers do have: the availability of qualified personnel at salaries much lower than the international norm, which would enable them to offer intensive training of the respective staff at costs much lower than those of suppliers from industrialized countries and with the enormous advantage of speaking Spanish.

At the same time, the design and production personnel have been trained in the hard school of producing MT originally designed for the industrial infrastructure of very advanced countries, in highly adverse conditions where the lack of many elements and the enormous fluctuations in economic activity must be compensated by ingenuity, flexibility and capacity to adapt to circumstances.

Moreover, the fact that all the leading firms are medium-size enterprises working with national capital (no firm has more than 200 employees) which have survived the crisis in which Argentina was engulfed in recent years attests to good management abilities. In turn their size gives them a degree of independence in management operations and the transfer of technology which large firms in industrialized countries do not have or which is confined to the large markets in which they operate.

B. The industry in Brazil 7/

The production of MT in Brazil began in the 1930s, in the context of an import substitution policy. During the Second World War, domestic production was intensified and in those years the two major firms which currently lead the sector were established (both were linked to the production and maintenance of agricultural machinery).

With the advance of the industrialization process, the establishment of the motor industry and the development of capital goods production, the demand for MT increased considerably as from the end of the 1950s and many small- and medium-scale national firms were set up. Some of these firms did not survive the 1960s and in those years various subsidiaries of German enterprises manufacturing MT were established to satisfy the requirements of the motor industry.

The growth of the industry in the 1970s, while fundamentally a function of the dynamic internal market, gave rise to a flow of exports which reached a maximum of $72-$74 million in 1980 and 1981 (there are minor differences between the various sources). In 1980, 85 per cent of the value exported was destined for Latin

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7/ Our main sources in describing the industry in Brazil have been the works of Fleury (1988), Laplane (1988) and Wogart (1989).

America, with Mexico the main destination (it absorbed $42 million in 1980 and $27 million in 1981). The Mexican crisis seriously affected Brazilian MT exporters, particularly the leading national firms.

Exports fell drastically as from 1982 and have remained at relatively low levels since then, although there has been a degree of recovery in the amounts exported (table 8). Nevertheless, the export ratio in Brazil is one of the lowest in the world as can be seen in table 1.

With regard to the make-up of exports, these are highly concentrated in a few categories. In 1987, half the value exported was represented by stamping machines and 22 per cent by centre lathes. Only very small amounts of other MT were exported.

The ALADI/LAIA countries absorbed half of Brazilian exports in 1987, with Mexico as the main destination. 8/

With the crisis, production also sagged to a low in 1983. It has since then been slowly climbing back to the dollar amounts which it recorded before the crisis (table 8).

As far as imports are concerned, these fell markedly to a minimum in 1985. Imports increased somewhat in 1986 and 1987 (table 3). Nevertheless, these play a small role in apparent consumption. As can be seen from table 1, Brazil shares with Japan the privilege of being the most self-sufficient country in the world in MT, since imports only accounted for 8.8 per cent of apparent consumption. In 1987, taking the value of imports from table 3, they represented 17.9 per cent of apparent consumption.

The low level of imports is a matter of concern in a country with such a manufacturing sector since it is thus depriving itself of many technological advances which local MT producers do not have.

Local production of CNCMT began in 1975 in the leading firm and was followed in 1977 by German subsidiaries. Production significantly increased in the 1980s from 120 units in 1982 to 1,018 in 1987, all for the internal market. 9/ Imports remained at low levels and increased significantly in 1986 and 1987 (table 8).

In Brazil, CNC units have also been produced since 1982, in some cases with imported technology and in others based on local efforts. In addition to firms specialized in this type of product, of which one manufactures high-cost units under licence and the other, without licence, low-cost unsophisticated controls, the main manufacturer of MT also produces its own CNC units.

8/ The stamping machines included in Brazilian exports to Mexico and which represented 94 per cent of the total exports to that country in 1987 are not included in the import statistics of Mexico under the heading 84.45. Consequently the statistics mentioned in the chapter relating to Brazilian participation are undervalued.

9/ The value of CNCMT manufactured was $187, 198 and 224 million in 1986, 1987 and 1988 respectively.

Despite the fact that production has already been going on for several years and the level of local integration is relatively low, prices of units are higher than the international norm (1.6 in 1987), although they are falling, so that CNCMT production is destined only for the internal market (except for the above-mentioned exports to Argentina). However, the prices of the low-cost units are below international levels and several manufacturers are gaining in competitiveness (Laplane, 1988).

Eighty-three firms are involved in MT production, but the sector reflects a wide diversity of scale, technological development and propensity to export.

The three major manufacturers are firms operating with national capital and on a large scale (over 1,000 employees). Based on the data in the annual balance of the Gaceta Mercantil for 1986, it can be seen that the largest firm, Romi, had a turnover in 1985 of $43 million, with a work-force of 3,300, employees and devoted significant resources to research and development.

The leading enterprises were followed by several medium-scale German subsidiaries which had a turnover of $2-5 million. There are also several medium-scale Brazilian firms and many small enterprises.

According to Fleury (1988), the large Brazilian firms and some of the medium-scale ones export conventional MT on a systematic basis (some have export ratios of the order of 20 per cent and have benefited from the BEFIEX programme incentives) and manufacture and are equipped with CNCMT. The remaining Brazilian enterprises are much further behind technologically and only export sporadically.

The German subsidiaries are specialized in high precision and high-output MT for the motor and motor spares industry, receive product technology from their parent companies (in some cases they have to adapt it to Brazilian conditions, for example, to local CNC) and also export sporadically.

Table 8

PRODUCTION, EXPORT AND IMPORT OF MACHINE TOOLS IN BRAZIL
(in millions of dollars and units)

	P	X	M	C	P/X %	M/C %	P CNCMT(u)	M CNCMT(u)
1980	314.8	71.2	175.3	418.9	22.6	41.8	62	32
1981	305.0	73.9	123.6	354.7	24.2	34.8	69	55
1982	172.5	20.7	85.2	237.0	12.0	35.9	120	30
1983	98.1	24.1	44.2	118.2	24.6	37.4	150	30
1984	104.7	20.2	39.2	123.7	19.3	31.7	153	53
1985	265.0	28.0	39.3	276.3	10.6	14.2	413	60
1986	370.0	39.0	48.0	379.0	10.5	12.7	853	180
1987	575.5	23.0	49.0	601.5	4.0	8.1	1 018	150
1988	448.9	35.9	40.0	453.0	8.0	8.8	742	n.d.

Note: Import values are lower than those contained in table 2, which come from another source.

Source: American Machinist and Laplane (1988) for CNCMT.

Concerning the competitiveness of Brazilian production of conventional MT, the low labour costs compensate for the higher component costs. Based on an estimate made in 1987, with the exception of electric motors which cost 20 per cent less than international prices, the remaining components were much dearer (from 20 per cent in the case of castings to prices two or three times higher in that of electrical and electronic components). Nevertheless, other estimates stated that metal details and castings (which in the leading firms are made in the same establishments) had international prices.

Another factor which makes Brazilian production competitive is economies of scale, particularly in conventional MT.

Although the quantity of CNCMT recently produced would also permit economies of scale in this key category, it would seem that the negative impact of electronic components and the technological backwardness of the main products conspire against the competitiveness of CNCMT produced in Brazil. An illustration of this is that none of the machines has been exported to Argentina, although those produced there had good penetration into the Brazilian market, as we indicated above. In any case, in both countries the production of CNCMT has difficulty in competing in unprotected markets with Asian and European suppliers.

The Brazilian industry is certainly competitive in the production of some conventional MT and has long accumulated technological experience. Many of its products have had a good market in Latin America and have continued to be exported, although in much lower quantities in the 1980s. With respect to product and process technology there is no doubt that the leading enterprises with national capital have valuable assets available for transfer to firms in other countries which decide to initiate co-production.

The greatest weaknesses of Brazilian firms lie in the excessive size of the leading manufacturers. Although size could be an indicator of enterprise capacity, we believe that in this case it is an unfavourable aspect for the transfer of technology to plants which must of necessity be much smaller.

In the case of medium firms, the excessive orientation towards a large internal market protected from international competition is certainly not a valuable attribute for the transfer of technology to other, smaller countries which are more open to external competition.

Finally, over and above its possible appropriateness for the development of electronics in general, we believe that the policy of market protection does not in this specific case appear to have been a success and has prevented Brazilian manufacturers of MT from obtaining not only the most economical but also the most technologically up-to-date electronic components.

C. Production in Mexico and other countries

Even before the crisis and opening up of trade, the MT industry in Mexico had not succeeded in achieving self-sustaining growth despite the enormous importance of the market which, in 1981, was tenth in the world and which even now effects some exports, particularly to the United States.

Based on the information contained in the NAFINSA-UNIDO report (1985), the situation in the sector in the mid-1980s can be summarized as follows. Of 30 manufacturers which existed in Mexico in the mid-1960s, 20 years later only 13 enterprises of significance in the branch remained, of which three were para-statal and exclusively dedicated to MT manufacture while the remainder were private, manufacturing other products as well.

In 1980, national production satisfied only 7 per cent of national demand and consisted largely of very simple MT, required mainly by workshops and technical schools.

Despite the fact that various manufacturers relied on manufacturing licences from socialist countries and Italy, Spain and the United States (ALADI/LAIA, 1983), "... with very few exceptions Mexican production of machine tools can be described as of a quality below international requirements, with a relatively low level of integration, except for simple products such as saws, toggle planes, some bench lathes and certain forming machines" (NAFINSA-UNIDO, 1985, p. 142).

To cover some of the large gaps occurring in national production, some investment projects were formulated, which apparently were not implemented, for the production of centre and vertical lathes, boring-milling machines and planing machines, shearing machines, folders, hydraulic and mechanical presses etc.

The difficulties which Mexico has had in progressing in this branch, unlike what has occurred in other branches of the capital goods industry, would merit a detailed study in order to reach a satisfactory diagnosis.

In addition to these structural difficulties, it must be borne in mind that the economic stagnation and opening up of trade in Mexico since 1985 complicated to a much greater extent the prospects for national production. The State has attempted to dispose of the MT factories which it possessed (which were inactive) but they still have not found any takers. Moreover, it must be remembered that, as we saw in the previous chapter, the demand for MT as measured by imports has fallen significantly, although it continues to be the highest in Latin America.

In Colombia during 1982 fifteen enterprises manufacturing MT (half of them jointly with other products) were identified, employing a total of 500 people. Three of these firms had foreign licences while the remainder utilized local technology based on imitation of imported models. Also in the same year there were in Peru four enterprises manufacturing MT, three of which subsequently closed down (ALADI/LAIA, 1983).

The metal engineering programme of the Andean Group (decision 146) included the production of certain MT in various countries, and production of some MT in Colombia, Peru and Ecuador was confirmed. In this connection it is worth mentioning that some Colombian exports to Ecuador, Peru and Venezuela are recorded (for amounts which varied between almost $1 million in 1983 and $386,000 in 1986). However the programme was not in the end implemented as had been envisaged and the policy to be followed in the metal engineering sector is being redefined.

From this chapter, it can be concluded that the difficulties encountered in the region in producing MT, with the exception of Argentina and Brazil, are significant. Moreover these difficulties were already in evidence before the crisis, in the more propitious context of import substitution and the growth of productive investment.

V. OPPORTUNITIES FOR SETTING UP CO-PRODUCTION PROJECTS

In discussing opportunities for setting up co-production projects, a clear distinction must be made between the situation in those countries of the region which have significant demand and a certain level of development of the metal engineering industry but can show little or no progress in the production of MT, such as Mexico, Colombia, Venezuela and other smaller countries, and the situation

in Argentina and Brazil. In the first case, which is of greater interest for the future of the region, there could be an attempt to launch co-production projects in which firms of the respective countries would be partners of Argentine and/or Brazilian suppliers. In the second case, there could be an attempt to launch joint projects between Argentine and Brazilian firms to satisfy mainly but not exclusively the extended market of both countries.

A. Financial, technological and organizational requirements

From the financial point of view, the production of MT is clearly not a large-scale project. Depending on the type of MT to be produced, its level of local integration and whether it is a new production line in an already existing plant or a new project, one can range from small projects whose investments in fixed assets would be lower than $1 million up to large-scale projects for producing CNCMT which can involve investments of the order of $50 million. Between these extremes, there is a range of medium-sized projects whose scale will depend on the type of MT to be produced and whether or not it involves the diversification of an existing firm.

Although for large projects investment in fixed assets is considerable, compared with other industrial sectors we are of course speaking of relatively small investment sums. From the point of view of financing it is also necessary to take account of the fact that the bulk of fixed assets also consists of MT, since to manufacture MT it is basically MT that are needed. When these are imported, they can be financed by supplier credit which most manufacturing countries have available, including Argentina and Brazil.

While the financial requirements for undertaking co-production projects are relatively simple, this is not the case with the technological requirements. In order to set up MT production, the main problems are technological and organizational, and are related above all to that fundamental asset of MT manufacturers: qualified personnel.

As was shown in the previous chapter, the normal pathway followed by MT manufacturers in Argentina and Brazil was slow accumulation of technical capabilities founded on the engineering inventiveness of immigrants - first repairing imported MT, then producing relatively simple MT based on imitation or copying, and subsequently embarking on manufacture of MT of a higher level of technology as regards scale, performance and precision.

Although the subject has not been adequately studied, the role played by immigrants mainly of Italian origin in the growth of MT industries in Argentina and Brazil is a very significant factor. It would appear that the absence of such immigrants in other countries of the region could have been one of the reasons for the lack of development in the branch under consideration.

The shift from an almost artisanal form of production at the start to the creation of a true manufacturing organization requires a gradual accumulation of technical knowledge. This maturation sequence implies the development of technical capabilities, first of all in product engineering, i.e. the basic and detailed design of the product to be manufactured. As the physical volume of production and the quality of the product increases, there arise serious problems in organizing the production process within the plant and in relation to the sub-contractors, which makes it necessary to develop process engineering and almost always to acquire more sophisticated equipment.

The increase in product quality implies new sub-processes (and the incorporation of the related equipment) such as tempering or heat treatment, grinding, etc.; the increase in vertical integration (for example, having or not having an own foundry or improving the quality of available smelters); introducing new skills to technical and production staff, etc. (see Katz, 1982, for a detailed analysis of these historic sequences).

Despite the fact that manufacturing licences are utilized in this industry, the imitation of models is the most frequent procedure, with trade fairs where MT are exhibited being the primary place for observing visible technical progress. However, imitation and then the development of products implies a design capacity which engineers and project technicians acquire over many years. This design capacity is not the only key qualification for the MT manufacturer, although certainly design is a basic asset.

Production process engineering is the organization of batch production in small runs and normally requiring several months to complete each product. It implies tasks such as designing plant distribution, preparation and organization of work in each of the machines in order to carry out the various operations (turning, milling, grinding, etc.), avoiding idle time, time-and-motion study, organization of sub-contractor services, etc.

Although this process engineering can be accelerated by recruiting specialized personnel, it also implies a significant maturation process within the plant in order to achieve improvements with regard to productivity and product quality.

As the marketing of MT is generally performed through specialist distributors and by exhibiting at fairs, marketing is less significant than production engineering in this case. However, international marketing and after-sales service, particularly for complex machines, are key factors in achieving commercial success.

To the qualifications of technical and engineering staff must be added those of operating staff. MT operators are highly skilled and if some of the artisanal characteristics of their work have been lost with the incorporation of CNCMT, there is no doubt that they are among the most highly qualified classes of operator. Their training involves not only specialist technical skills but also a long apprenticeship on the job.

The training of operating, technical and engineering staff is clearly a long-term task. If there is already a significant level of metal engineering production, the specialist re-training of existing personnel in the production of MT is a difficult but urgent task, where inputs by the supplier of the technology can be very valuable.

In this sense, it is necessary to take account of the fact that, in addition to the sequential form described, another pathway utilized to enter the manufacture of MT has been that of the users themselves. Motor and motor parts manufacturers, agricultural machinery manufacturers and manufacturers generally in the metal-engineering area have the technical ability to manufacture the MT they need, although not on a commercial scale.

It is for this reason that, where there are no manufacturers of MT interested in modernizing product already being manufactured or in adding a type of MT which it does not itself produce to its production line, other metal engineering manufacturers (for example manufacturers of non-standard spare parts or short-run

products such as liquid pumps, velocity reducers or electrical equipment) could be potentially interested in co-production projects. 10/

The technological requirements are clearly the fundamental ones in a co-production project. They involve stringent demands as regards training and re-training of engineering, technical and operating staff, so that over an appreciable period of time (one should think in terms of years and not of months) the new plant can begin to manufacture products of consistent quality and a good level of industrial performance.

In order to justify all this work of training staff, the operation to be set up must not simply consist of assembling imported parts or components, although it may have this character in the first year of operation.

As the level of local integration of production increases, the development policy of suppliers becomes crucial. In this connection, it is essential to achieve local integration of production, avoiding excessive vertical integration of the MT manufacturing enterprise itself.

Bearing in mind that forging and casting normally involve half the value of national input in the manufacture of an MT, this implies, for example, that the MT manufacturer should not have either a forge or a foundry in his own plant since in general these activities are expensive and insufficiently used by an individual manufacturer. Moreover, it is to be presumed that in the country in question there is a certain level of development of forging and casting which makes it feasible to place a new demand on existing establishments.

Metal components are another of the major items in MT manufacture, particularly in forming machines. The availability of national production at relatively competitive prices would obviously make local supply of these items feasible.

In addition to metal and casting inputs, MT require an infinity of parts and components many of which are standardized, such as bearings, couplings, nuts and bolts, control and command mechanisms, electric motors, components of electrical and hydraulic circuits, rollers, paint, guards etc. It is probable that there are local suppliers of these items but if it is not feasible to develop them in a reasonable time and at reasonable prices it would be better to import them.

As clearly the development of suppliers cannot be undertaken for an individual factory, it is necessary to examine in depth existing suppliers of other lines and see to what extent they can adapt their production to the new needs.

Assistance by the supplier of MT technology can, without doubt, be fundamental to the task of developing suppliers of parts and components. Nevertheless, it must be borne in mind that his views may at times be biased towards the import of parts from the country supplying the technology, simply because he is used to working with those components.

10/ In this and other points in this chapter we have drawn on the observations of Ing. Eduardo Fernández who has just carried out a mission to Mexico, Venezuela, Colombia and Brazil and produced a report on co-operative agreements related to the machine tools sector for UNIDO.

In summary, the establishment of a co-production project presupposes the existence of interested entrepreneurs in the receiving country and, of course, the formulation of policies which make the project possible, a subject which we shall deal with in the next chapter. These entrepreneurs could be manufacturers of MT or other metal-engineering products and, possibly, distributors of imported MT, preferably from the country of origin of the technology.

The development of a co-production project supposes an intensive transfer of product and process technology and probably a form of entrepreneurial organization of the joint venture type between the local firm and the supplier of the technology.

In this light, what advantages and disadvantages do Argentine and/or Brazilian MT manufacturers have for potential suppliers of technology in the industrialized countries as regards actually providing the technology in question and forming a joint enterprise?

In the first place, these two countries have a long experience in production and process engineering in an industrial environment which is however far from possessing all the manufacturing facilities available to MT producers in industrialized countries. The engineers and technicians who work in these factories have had to compensate with ingenuity and much adaptive invention for the unequal quality and uncertain delivery times offered by local suppliers; they have had to adapt the final product to the requirements of very varied users; and they have developed a particular skill in tackling problems of maintenance and service of the machines used in the manufacturing process.

In the second place, the costs of man-hours for engineers, technicians and operators in MT factories in Argentina and Brazil are substantially lower than those of the industrialized countries, including those currently applicable in Taiwan and South Korea. Since the basic component in the technology transfer process is training, this is a fundamental advantage which Argentine and Brazilian suppliers have in comparison with other potential suppliers. Moreover, the fact that they speak Spanish (or Portuguese) not only eliminates translation costs but also clearly facilitates the process of communicating the knowledge in question.

Thirdly, MT produced in Argentina and Brazil, although far from the international vanguard, are certainly competitive in the intermediate product range and are in certain cases machines of some degree of technological sophistication. While industrialized countries do indeed produce this type of MT, it is not easy to find firms prepared to transfer all the relevant technology, although they may offer the relevant plans.

Even with CNCMT, it is a case of machines whose technology is between five and 10 years behind those produced by leading manufacturers but which, in Argentina at least, are fairly competitive with regard to price and performance. This implies that in relation to the incipient local production, the beginning of manufacture of MT of Brazilian or Argentine origin is certainly a great leap forward and an accumulation of technical knowledge. Clearly this should not prevent the taking of licences or undertaking joint enterprises with suppliers from industrial countries for more sophisticated machines in the medium term.

Finally, the fact that Argentine and some Brazilian firms are medium-scale enterprises with some experience of exporting but without the responsibility for supervising numerous subsidiaries abroad certainly facilitates a more fluid and simpler process of communication with the acquirer of the technology.

Set against these possible advantages of Argentine and Brazilian suppliers, it is important also to spell out their limitations.

Despite efforts made, the distance separating Argentine and Brazilian manufacturers from the international norm is significant and may continue to increase. Thus in terms of high technology, European and Japanese manufacturers and some United States manufacturers are clearly superior to the Latin Americans. However, in Europe, Japan and the United States, there are medium-size firms which may also be prepared to transfer their technology (as has occurred with the leading Argentine firm).

With regard to countries with a limited tradition in the manufacture of MT, the major question mark is whether they can skip stages, that is, pass directly to the manufacture, for instance, of CNC lathes without having mastered the manufacture of conventional ones.

It may be asked, for example: why train operators and engineers to produce conventional machines if, in order to produce CNCMT, many of these qualifications are of little relevance and it is worth concentrating efforts on qualifications in greater demand?

Although we have not had the opportunity to acquaint ourselves with detailed studies on this aspect, experience shows that to manufacture CNCMT a high degree of skill in mechanical engineering is needed and that it would not be feasible to skip stages, i.e. to enter mecatronics without mastering mechanics.

The mechanical engineering stage is crucial and furthermore mechanical engineering represents between 70 and 80 per cent of the value of a CNCMT. The electronics is fundamental and also requires a good basis of electronics engineering, even when the control units are obtained from specialist suppliers.

Given that we do not believe it feasible to skip stages, European or Japanese suppliers would have fewer advantages than Latin American ones. Nevertheless, the technological superiority of these leader firms is also primarily based on mechanical engineering and not only on electronics or mecatronics. Thus, even without skipping stages, it would appear that if the variable key is the technological level achieved by the supplier, the balance should incline towards non-Latin American suppliers.

A second element in favour of non-Latin American suppliers is the great export experience of the Europeans and Japanese while Argentine and Brazilian firms have until recently been oriented towards the internal market. While this orientation is a key factor and would justify thinking in terms of possible production operations with a strong export orientation, for example towards the United States market, it is worth bearing in mind that MT manufacture implies a whole complex process of technology transfer which would be scarcely practicable if the aim was merely to take advantage of labour or transport costs. In particular, we have no indication that, and it seems improbable that, for example, MT are being assembled by Mexican industry for export to the United States.

Finally, in addition to their technological and organizational capacity, European and Japanese firms have financial and institutional support which is rarely found in Latin America. Such support ranges from lines of preferential credit for acquisition of the MT needed to start the operation, to guarantees and insurances for the respective investments.

For the reasons set out and because it does not appear feasible to proceed to the manufacture of complex MT such as CNCMT without mastering the production of more simple MT for which demand is significant and, as we saw in chapter III, is covered basically by imports in several countries of the region, it would seem that

Argentine and/or Brazilian manufacturers are relatively well-placed to be technologically viable partners, for non-Latin American suppliers, to undertake co-production projects in several countries of the region which may decide to promote them and where a certain entrepreneurial interest has been noted.

B. Opportunities for co-production between Argentine and Brazilian firms

The significant flow of trade originating in Protocol No. 1 of the programme of co-operation and economic integration between Argentina and Brazil was based on installed capacity and has not given rise, as was originally envisaged, to the creation of a co-production capability. This can be explained by a number of reasons which will be analysed in the next chapter and which range from the complicated macro-economic picture to the failure to implement basic instruments envisaged in the integration programme such as the legal status of bi-national enterprises.

It is possible nevertheless to suggest areas where Argentine and Brazilian enterprises could undertake joint activities including the co-production of certain lines of MT or of parts and components. At the same time, it is important to see clearly the obstacles which may prevent such undertakings.

Instead of the situation prevailing at the present time in which both countries basically produce the same MT (although Argentina in less quantity and less variety than Brazil) as a result of the import substitution process followed and where there is a high domestic integration of production as a consequence of the high degree of vertical integration of many plants, the ideal scenario should be very different. Starting from a fundamental restructuring of both MT industries, an industry should be achieved which is more specialized and flexible both in the production of complete MT and in parts and components, with its principal guideline being respect for a high degree of local integration combined with vertical de-integration at manufacturing plant level.

Such a scenario would not only assume significant support in the economic integration process but also close co-ordination of the currently non-existent industrial and technological policies for the branch under consideration.

Since a scenario of that kind does not appear on the horizon, more modest initiatives should be considered.

Firstly, despite the fact that a good range of MT is produced in both countries, it is possible that with the demand of the extended market the manufacture of certain types of MT could be begun (in general technologically sophisticated MT) which up to now have been imported from third countries. Nevertheless, given that the Argentine market only adds between 20 and 30 per cent to Brazilian demand and has not been notable for its dynamism, it is not likely that there are too many specific opportunities for import substitution along this road.

Secondly, it would be more feasible to set up joint projects on new models of MT which at the present time are manufactured in one or other country or have not yet been produced in either of them. In order to face together the growing costs of designing new MT and to join forces in product engineering, the ideal would be to establish joint design projects for a new model of MT. If through lack of confidence or other reasons, joint design projects were not feasible, in the first instance it would be possible to think of reciprocal or unilateral licence

agreements for certain key models so that MT are produced in one or other country or in both countries in existing plants.

Joint design projects could relate to parts and components including hardware and software for the electronic part of the MT (even within the policy of reserved markets operating in Brazil up to 1992) and not necessarily only to complete MT.

Thirdly, by extending the common list to include effectively parts and components, it would be possible to consider sub-contracting specific parts and components to one or other country, thus reducing the vertical integration of MT manufacturers and intensifying economies of specialization in the manufacture of parts and components.

Finally, it would be possible to develop technological exchange projects relating to process engineering, total quality control systems, specific methods such as group technology and modular manufacture, etc. These technological projects would imply a process of exchange of personnel and joint training of new staff. To give these projects greater viability it would be preferable to establish them at the level of associations of manufacturers or technological institutes such as INTI in Argentina and IPT in Brazil rather than only at the level of individual manufacturers.

The major difficulties which arise in establishing joint production projects - in addition to those derived from the macro-economic environment and specific policies - originate from significant differences of scale and sources of capital as between both industries, their different level of integration and the heterogeneity and individuality of the main firms involved.

On the basis of the data examined in chapter IV, the differences of scale between leading enterprises are clear. Total Argentine production is of the same order of magnitude as the output of the chief Brazilian manufacturer, although it is true that this manufacturer is of a size unusual in international terms. Furthermore, several of the leading enterprises in Brazil are subsidiaries of German firms with which opportunities for co-production are more limited than between national firms.

Nevertheless, whereas the differences of scale between the leading firms in both countries would make the relationship too unequal to think of joint enterprises, these would be perhaps more feasible between leading Argentine firms and medium-scale enterprises in Brazil. In this latter case the technological differences would perhaps be more accentuated and it would be more difficult to envisage joint design projects or reciprocal licences, but unilateral licences would be possible.

The high degree of vertical integration of the leading firms in Brazil (and to a lesser extent in Argentina) takes away degrees of freedom from projects aimed at stimulating the manufacture of parts and components. In general, the higher degree of national integration of production in Brazil makes progress in the area of components more difficult, as experience in the negotiation of the common list for the capital goods protocol has been showing.

The need for technological updating, while fundamental to the progress of the industry, does not necessarily lead to joint projects. Some leading firms in both countries have already established large-scale projects with suppliers from industrialized countries and it is difficult to think that these projects could be redesigned to accommodate another partner.

Finally, given the rivalry and individuality with which MT manufacturers operate 11/ it is not impossible that, when considering expanding factories in the neighbouring country, they will do so directly by establishing wholly controlled subsidiaries, as has occurred with one of the leading enterprises in Argentina which has a factory in São Paulo, or by acquiring established firms in the other country.

VI. REQUIRED POLICIES

A. In countries with little or no development of local production

Even though MT manufacture is an activity in which small- and medium-scale enterprises predominate and economies of scale are not significant, the problems connected with the production of MT for industrial sector use are serious, as shown by the experience of those Latin American countries which have attempted to develop this branch of industry.

Moreover, the attempts to stimulate domestic production were made in a general context of import substitution which was more propitious than the current situation.

Although a study of the obstacles to the development of local production would certainly cast more light on the specific problems facing each country, it is not unreasonable to think that the main difficulty lies in the human resources needed to develop this activity. As indicated earlier, these human resources cover a range of mechanical engineering skills and require a long period of accumulating technical knowledge before coming to fruition.

On the basic premise that there is an appreciable demand for MT 12/ which, in turn, presupposes the existence of a metal engineering industry that is the principal MT user, MT production involves the formulation of policies in the following areas:

(a) Protection against imports;

(b) Financial and fiscal incentives for local MT manufacture and the purchasing of nationally produced MT;

(c) Training of skilled product and process engineering and production personnel;

(d) Acquisition of technology, including manufacturing licences and/or joint enterprises with foreign suppliers.

11/ Neither can the fact be omitted that the commercial success of Argentine manufacturers in the Brazilian market caused an adverse reaction on the part of Brazilian producers of MT who, among other things, argue, but without much evidence, that MT exported from Argentina have a low level of national integration.

12/ From the data examined in chapter III, it seems that demand in excess of $10 million per annum would be sufficient to consider promoting local production. Apart from the obvious cases, such as Mexico, Venezuela and Colombia, countries such as Peru and Ecuador might look closely at this possibility.

1. Commercial policy

It is unthinkable to promote MT production without appropriate tariff barriers against imported MT. The period of apprenticeship and the development of MT at prices that are reasonably competitive with imported products render protection necessary. None the less, such protection should:

(i) Be time-limited, i.e. covering the apprenticeship period;

(ii) Be repressive, to follow the downward trend in production costs;

(iii) Be based on ad valorem tariffs and not on non-tariff restrictions, with suitable arrangements to prevent dumping;

(iv) Take account of the fluctuations in the true rate of exchange, which sometimes render tariff-protection redundant or, at other times, inadequate;

(v) Permit the import of parts and components, as well as all MT which are not locally manufactured, at a zero or very low tariff.

Protection along these general lines is rather different from the protection that used to be given to industries qualifying for promotion during the import-substitution period. This protection is founded on the industrial policy objective of making production competitive in the medium term (let us say five years). Competitiveness must be based not only on prices, but also on performance and after-sales service, factors which are sometimes more important than prices.

Nevertheless, although protection of the kind proposed fits in with the commercial policy that is being increasingly adopted in developing countries (see UNCTAD, 1989), the preference for tariffs rather than non-tariff restrictions is substantially different from the approaches that are currently in vogue. The essential difference lies in the fact that the tariff policy is an industrial and technological development policy tool for a particular branch, instead of relying on a mere reduction in tariff protection and world market competition to cope with this complicated task.

Protection of the end product, availability of inputs and of the MT required for production at international prices and very low labour costs, which constitute the main element of the production cost, are the principal incentives associated with the production in question. The proposition is all the more viable if the country has available iron and steel products and grey iron at prices close to international levels.

In order to ensure that the purchasers of the MT to be manufactured locally are not excessively disadvantaged until local production becomes competitive, it is essential to have lines of financing for the purchase of nationally-produced MT. Furthermore, it is important to bear in mind that MT demand is rather inflexible with regard to prices and performance, and the services that a producing firm can offer are very much taken into account by purchasers.

Even so, one must not lose sight of the fact that, as far as MT users are concerned, local MT manufacture involves a short- and medium-term cost burden. These initial costs ought to be offset by the benefits of having a local MT industry that is competitive and innovative. If these benefits are to be effectively utilized, it is essential that, among other things, protection should gradually diminish and should be time-limited.

2. Incentives policy

As is usual with sectoral promotion policies, local production is normally promoted through fiscal benefits and preferential funding.

Although the current difficult fiscal situation of the Latin American countries militates against the granting of tax reductions, if such relief is applicable to other promoted activities it is reasonable that it should also be allowed for MT manufacture.

In any event, rather than providing relief for fixed asset investments (for which it would be better to provide preferential funding arrangements), it would be more advantageous to grant fiscal incentives for manpower training and for technological development projects.

The availability of preferential funding for fixed assets purchase is a significant incentive in obtaining the necessary equipment to cope with production.

In addition to this line of financing, wide use has been made in industrialized and developing countries of preferential funding for purchasers of nationally-manufactured MT and, in some instances, special tax reductions for such purchases.

3. Personnel training policy

Personnel training is a far-reaching task and should be approached initially through the specialized State agencies, subsequently with reference to the sector as a whole, and finally at the individual industrial plant level.

MT manufacture needs workers with specific skills who are normally drawn from vocational or technical schools at the secondary education level. Although MT manufacturers have to recruit graduates from general technical schools, as demand rises it is very important to establish specialized schools for MT workers.

MT manufacturers should be actively involved in these schools with regard to the curriculum, the MT used for practical exercises and the provision of apprenticeships for students. Moreover, since the graduates of these schools find employment not only with MT manufacturers but also in the metal-engineering industry in general, as operators of lathes, drills, grinding machines, etc., MT purchasers should also maintain links with the establishments in question.

The training of the technical and engineering personnel needed for MT design tasks and for the various aspects of the production process technology necessitates specialized courses for engineers and engineering technicians. As well as such courses being offered at universities or higher technical schools, they are also frequently provided in post-graduate schools or specialized technological institutes.

Since the initial demand for specialists of this kind is obviously too slight to generate this type of training, the main thrust must be made at plant level and through specific efforts by the technology supplier and/or through apprenticeships abroad.

None the less, any long-term MT manufacturing initiative is unthinkable without a policy on the training of specialists. The establishment of training schools for specialists of this kind on a country-by-country basis is inappropriate, and training could be a fruitful area for regional co-operation.

4. Technology policy

Although it has been customary to imitate foreign models when developing local design capability in the MT industry, a simpler way to avoid the numerous failures in that sector is to acquire technology under licence.

Licences of this kind normally transfer product and process technology and provide for personnel training. In many instances the technology supplier participates as a shareholder, and manufacture becomes a joint undertaking.

If such licences are to be an appropriate instrument for developing the technological capability of the receiving firm, it is essential that a conscious effort be made by the local manufacturer to utilize his available human resources for that purpose. What is involved is not only learning the manufacturing technology and production organization - certainly not trivial tasks in this branch of industry - but also being able gradually to generate an in-house design and process engineering capability. In short, the licence must contribute to the local manufacturer's technological development and not merely be a substitute for this.

As already mentioned, MT manufacturers in Argentina and Brazil have substantial claims to be considered as possible technological partners in the promotion of production capability, above all because of the scale and the cost of personnel training that the operation requires. Nevertheless, given the complexity of the technological effort involved and the advances made internationally, a decision in favour of Latin American manufacturers must be made on the basis of a detailed examination of the various benefits and drawbacks they have in comparison with suppliers in Europe, North America or Asia - a subject on which we have already commented in chapter V.

Even though licences and joint enterprises are appropriate means of acquiring the relevant technology, it inadvisable to be dependent only on that source. It is thus essential to continue to develop a technology capability, not only in the individual manufacturing enterprise but also nationally.

More highly-developed industries have wider-ranging technological requirements which licensors are frequently unwilling or unable to cover, and this is where technological institutes, such as those which exist in certain countries (e.g. the Metal Industry Research Laboratory in Taiwan and the Korean Advanced Institute for Science and Technology in South Korea), come into their own in the development of products which are outside the scope of an individual manufacturer.

Alongside these institutes, there are often public bodies which provide funding for technological development activities in MT manufacturing enterprises with an eye to reducing the risks inherent in developing new products or production processes.

5. Policy overview

The economic policies to which we have referred are essential in promoting MT manufacture in countries where that branch of industry does not yet exist or countries which have made unsuccessful attempts to promote it.

Success in establishing local MT production is a central objective of industrial and technological policy and, for this to come about, the procedures for mentioned above must be applied coherently and systematically. This is no easy matter in Latin America. If one opts only for a commercial policy or for financial

or fiscal incentives, this may, all being well, bring about local manufacture, but it would require ongoing protection and would, therefore, hinder the competitiveness of the user sectors in general.

If a commercial, industrial and technological policy of the kind suggested is envisaged, the possibilities of starting up co-production projects with Latin American technology suppliers are certainly significant. Against this background, the number of entrepreneurial initiatives will certainly increase and enhance the chances of success for the project in point.

In the absence of a set of coherent policies, the probability that any entrepreneurial initiative may prosper is very slight, as it certainly likewise is if any joint enterprises are established only for political reasons.

B. The case of Argentina and Brazil

In Argentina and Brazil economic policy should be focused on modernizing the MT industry as regards product and process technology, on increased vertical de-integration and on greater manufacturer specialization. Attainment of these objectives could help to establish MT manufacturers who are more competitive internationally in the field of technologically more sophisticated product lines.

An industrial and technological policy designed to achieve these objectives requires a twofold approach. Firstly, the existing industry needs to be restructured in order to achieve economies of specialization, in the production both of complete MT and of parts and components, in which restructuring process commercial policy should play a significant role in permitting larger imports of parts and components and of MT not produced in either country.

Secondly, technological progress in the sector must be speeded up, which implies the development of new MT models and an appreciable effort to improve production processes through the incorporation of new techniques to enhance quality and reduce equipment down time.

All these challenges call for the formulation of active industrial and technological policies in which commercial policy also plays a significant role.

Whereas Brazil has made certain attempts to establish an industrial and technological policy for the branch and the new industrial policy approved in 1988 could provide the framework needed to attain these objectives, such initiatives have been conspicuous by their absence in Argentina.

The Capital Goods Protocol set out a number of proposed objectives and stressed the need to co-ordinate the relevant economic policies in both countries.

In fact, no progress has been made in this area and some of the key instruments figuring in the Protocol and in the Integration Programme have not been put into practice. The investment fund to finance co-production projects, the bi-national enterprise status which would provide the legal basis for such initiatives and the failure to include parts and components in the common list are fundamental omissions from the instruments appearing in the integration programme.

This situation, plus the complicated macro-economic background, has meant that the Protocol has thus far been an efficient instrument for the promotion of trade on the basis of installed production capacity (see Chudnovsky and Porta, 1989). However, the medium-term objective is certainly to introduce new installed capacity on a joint basis, with Argentine and Brazilian firms specializing in certain production lines and inputs and/or carrying out joint technological activities.

The fact that this objective has not been achieved up to the present time and also that at least one leading firm in each country has substantial plans for increasing physical and technological capacity with partners in industrialized countries clearly shows that at entrepreneurial level at least there is concern on the score of technological modernization. Nevertheless, the present situation definitely discourages entrepreneurs from supplementing these projects with joint activities between Argentine and Brazilian firms.

In the field of technological progress, possibilities of working out production and development plans for new projects on the basis of joint activities by Argentine and Brazilian firms do exist, even though they have to face the obstacles mentioned in chapter V.

One feature which is highly critical in any policy of technical progress is the market protection applied in Brazil in respect of computer products, particularly CNC units. Leaving aside the question of the advantages of this policy, the fact is that so far the units produced in Brazil are generally more expensive than those available on the international market and are much less advanced technically.

Whereas an expanded market might justify investments in the development and production of CNC units, proliferation of controls in Brazil and the policy of a reserved market make it difficult to see that much progress can be made in this area. However, it is possible that Brazilian policy will be amended as from 1992, and perhaps the possibilities of joint undertakings will then be taken into account.

In the context described above, there were various projects for producing CNC units in Argentina on the basis of licences from international suppliers and put forward on the assumption that there would be reciprocal treatment for units produced in Argentina. However, the uncertainty and the macro-economic problems troubling the country have postponed any possible implementation of such projects.

Paradoxical though it may seem, it would appear that the difficulties in the way of implementing policies for modernization of the MT industry in the two countries which have the longest tradition in this field and where, to some extent, a process of integration is already at work are no smaller than those facing countries which have no significant production.

This paradox may be explained by three highly diverse factors. Firstly, there is the scant room for manoeuvre available to industrial and technological policy in the face of the macro-economic situation in the short term. Secondly, there are the actual difficulties of the integration process in the macro-economic framework embracing the region and where investment in production is notable by its absence. Finally, the difficulties inherent in the technological transformation process which this branch of industry is undergoing world wide and which were described in chapter II mean that both manufacturers and policy makers are proceeding with great caution.

VII. SUMMARY AND CONCLUSIONS

MT production is a highly attractive activity for promoting industrial and technical development. It is a branch in which small and medium-sized firms predominate, which requires relatively low investment in fixed assets, and the key feature of which is qualified personnel. At the same time, MT are the bearers of technological change, and function as a powerful conveyor transmitting technological innovations to the economy as a whole. Its recognized technological

significance has been enhanced through the incorporation of micro-electronics into MT, thereby giving rise to CNCMT which, although often used on an individual basis, are a crucial component of flexible automation.

In spite of these attractive features, only a few developing countries, among them Argentina and Brazil, have succeeded in establishing this industry within their frontiers, and a considerable number of industrialized countries have experienced serious problems in maintaining competitiveness in the face of the changes in technology and in industrial organization which this branch has undergone and which have found their ultimate expression in the rise of Japan to the position of international leadership.

In an industry closely associated with international trade, in which imports cover more than 40 per cent of apparent consumption and exports 45 per cent of the output in the MT producing countries, imports have been the usual pathway for meeting MT requirements in non-producer countries, such as has happened in Latin America, with the exception of Argentina and Brazil which have achieved a significant degree of self-sufficiency, particularly Brazil.

Through the crisis which is affecting the region and the dramatic drop in investment in production, Latin American imports which had been nearly 10 per cent of the world total in 1980 dropped sharply and in 1985 were scarcely one third of what they had been in 1981. Although imports grew appreciably in 1986 and 1987, in terms of present-worth dollars they do not represent even half of what they did at the beginning of the decade.

Apart from Brazil, Argentina and Mexico (which absorbs half of the regional imports), Venezuela and Colombia are substantial markets and so to a lesser extent are Peru and Ecuador. In the other countries demand was small even before the crisis.

The region's imports are met mainly by the industrialized countries. However, the part played by the United States in the Latin American market, particularly in Mexico, is much more important than its role on the international market. In contrast, other countries which have overtaken the United States commercially and technologically, such as Japan and to a lesser degree Western Germany and Switzerland, have a smaller share of the Latin American than of the world market.

Argentine and Brazilian suppliers, who covered 9.3 per cent of the region's imports in 1980, saw their share reduced to only 2.3 per cent in 1986. It was only in 1987, with the agreement between Argentina and Brazil to promote the trade in capital goods, that the proportion of interregional trade attained 5.7 per cent of the total.

Both in Argentina and Brazil MT production began or accelerated with the Second World War, and immigrants of Italian origin played a significant part in the beginnings of the industry. In both countries development proceeded from the repair of imported machines to artisanal manufacture of simple MT and subsequently to industrial-scale production of more sophisticated machines.

With the increased demand brought about by the production of motor vehicles and other metal engineering goods, domestic MT manufacture increased considerably during the 1960s and 1970s, and a flow of exports began to move towards the other countries of Latin America.

Although the origin and the pattern of development of both industries are very similar, certain differences emerged at the outset and others appeared

subsequently. Whereas in Argentina the industry was always characterized by small and medium firms operating on national capital, in Brazil there exist not only establishments of this type but also large firms operating with national capital and in addition various subsidiaries of German MT manufacturing firms.

The progress of industrialization in Brazil in the 1970s speeded up the growth in MT production and promoted the technical modernization of the leading manufacturers. In contrast, the policy of opening up the economy had a far-reaching effect on Argentine MT producers who attempted to offset through exports the drop in the domestic market brought about by the policies followed in 1979-1981 and by the subsequent crisis. The shrinking of the world and Latin American market as from 1982 put a brake on exports, and the crisis inhibited production for the depressed domestic market, much more so in Argentina than in Brazil.

Although the crisis led to the disappearance of numerous firms and a reduction in the number of persons employed in the Argentine MT industry, some establishments which endeavoured to remain up-to-date in product engineering were able to increase their production as from 1986, firstly for the internal market and then, from 1987 onwards, for export purposes, mainly to Brazil. This is particularly so in the case of CNCMT manufacturers who have substantially increased the output of CNC lathes and applies also to the manufacturers of milling machines, conventional lathes, grinding machines and certain forming MT.

Technological variety likewise characterizes the Brazilian MT industry, where we have the co-existence of a number of large and medium firms operating on national capital and German subsidiaries with fairly advanced product engineering, suplemented by numerous medium and small firms which are technologically more backward. While the more advanced firms have substantial export rates, the exports by the other establishments are more sporadic. At all events, the Brazilian industry is directed basically towards the domestic market and both exports and imports of MT are of small significance.

CNCMT production increased considerably in Brazil during the 1980s, reaching a production of 1,000 units in 1987. On the basis of the market protection policy, CNC units are also produced. Except for simple control devices, the CNC units are substantially more expensive than those produced internationally, a factor which has sapped the competitiveness of Brazilian CNCMT.

Although notable efforts were made to introduce local MT production in Mexico, mainly by recourse to foreign licences, the market is essentially supplied by imports from the United States. In Colombia a certain degree of local production has been observed, as has also been the case in Peru, while Venezuela has apparently made no effort to promote MT production.

The difficulties experienced by these countries in developing domestic MT production reduced the possibilities of launching co-production projects.

The main requirements for projects of this kind are of a technical nature and consist basically of the skilled personnel which MT production demands. The training of engineers and technicians to cope with the problems presented by MT design, the organization of the production process, together with the availability of the skilled workers necessary for MT production are the key aspects associated with the manufacture of these items on an industrial scale.

Since we do not believe that it is feasible to skip stages and proceed directly to CNCMT production, we consider that Argentine and Brazilian

manufacturers are in a good position to become technological suppliers and partners for setting up joint enterprises aimed at producing certain types of conventional MT, for which there is a good market in countries such as Mexico, Venezuela, Colombia and possibly Peru and Ecuador.

The possibility of providing the long and complex training of the personnel required for these undertakings at prices much lower than those demanded by the industrialized countries and in the language to be used in practice are considerable advantages working in favour of Argentine and Brazilian suppliers. Also, the availability of personnel with experience of MT production in countries facing the problems current in Latin America is an advantage which no manufacturer from outside the region can offer. The relatively small size of the leading Argentine firms and of the medium-sized Brazilian undertakings is another favourable factor for carrying out the intensive technology transfer process which would be required.

Nevertheless, the Argentine and Brazilian manufacturers are not so technologically up-to-date, even as regards conventional MT, as are those of the industrialized countries and do not have the export experience possessed by the latter. Hence the choice of a partner for launching production projects should be made with care, although it is clear that both Argentine and Brazilian firms have serious claims on selection.

MT production in some of the countries in question requires not only appropriate entrepreneurial interest and the possible availability of partners in Argentina and Brazil but also of course specific policies to render national production a viable proposition.

In this sense it is of basic importance to formulate a set of closely interrelated policies in order to render the output in question adequate and competitive in the medium term. Firstly, temporary and regressive tariff protection would be required for the products concerned, together with minimum customs tariffs on parts and components not produced in the country. The aim is to afford protection during the period when the appropriate technology is being learned. Then, it would be necessary to grant financial and fiscal incentives for investments in fixed assets and the training of personnel, and to afford preferential funding for purchases of nationally produced MT. Thirdly, there would be a call for a sustained effort devoted to training personnel at all levels, by the State, by MT manufacturers and at individual plants. Finally, while transfer of technology by suitable partners is a vital channel for facilitating the start-up of production, inputs received from outside should supplement intensive effort on the part of local producers in order to create a domestic product and process engineering capability.

If such policies are not drafted and implemented, then irrespective of the intentions of entrepreneurs or of the political will of governments, the chances that mixed undertakings will end up by producing efficient and competitively priced MT are very remote. If these policies are not accompanied by a specific entrepreneurial interest, the operation in question likewise will not have very great chances of success.

Regarding the possibility of establishing co-production enterprises between Argentine and Brazilian firms, we consider that the potential here is small, in spite of the technological level which has been attained and of the importance possessed by the integration agreement in the commercial field.

In order to put these possibilities into practice it would be necessary to actuate various of the mechanisms envisaged in the Programme of Integration such as the status of bi-national enterprises and the Capital Goods Protocol, together with the inclusion of parts and components in the Common List. In addition to these instruments, an industrial and technological policy should be worked out for both industries, aimed at promoting specialization in the production of complete MT and of parts and components, on the basis of restructuring existing plant.

In the absence of dynamic industrial policies and in the context of a highly uncertain macro-economic climate, it will be difficult - if not impossible - to mount co-production projects or projects for technological development between Argentine and Brazilian firms, although for the technical updating and mutual integration of both industries it would be most desirable for such projects to be implemented.

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