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CONTENTS

Income distribution and poverty through crisis and adjustment <i>Oscar Altimir</i>	7
New directions for public management <i>Eugenio Lahera</i>	33
The petrochemical and machine tool industries: business strategies <i>Daniel Chudnovsky, Andrés López and Fernando Porta</i>	49
Productivity, growth and industrial exports in Brazil <i>Regis Bonelli</i>	71
Export processing in the Caribbean: the Jamaican experience <i>Larry Willmore</i>	91
Price elasticity of Central American agricultural exports <i>Alberto Gabriele</i>	105
Ecuador: the country's progress from chronic to moderate inflation <i>Luis I. Jácome Hidalgo</i>	115
New strategies of transnational corporations in Argentina <i>Bernardo Kosacoff and Gabriel Bezchinsky</i>	129
The informal sector and poverty in Latin America <i>Guillermo Rosenbluth</i>	155
Regionalization processes: past crises and current options <i>Sergio Boisier</i>	177
A cultural view of the ECLAC proposals <i>Fernando Calderón, Martín Hopenhayn and Ernesto Ottone</i>	189
ECLAC and neoliberalism: An interview with Fernando Fajnzylber	205
Guidelines for contributors to <i>CEPAL Review</i>	209
Recent ECLAC publications	210

The petrochemical and *machine tool industries:* business strategies

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Recent structural reforms in Argentina, Brazil and Mexico have set up entirely new conditions for competition. The biggest changes are those affecting trade and industrial policy and the system of public-private production relations. In this new environment, manufacturing firms receive less protection and less State assistance and have less leeway in which to devise price differentiation strategies for the domestic market. The orthodox literature and conventional wisdom in the region suggest that more competition will spur firms on to increase their activities and efforts in the field of technology. Others have voiced a dissenting opinion, however, arguing that a reduction in protection and assistance will put these firms out of business. Research findings suggest that neither the "increased-efficiency" nor the "de-industrialization" hypothesis will prove to be true in the immediate future; rather, they appear to indicate that the process is a much more complex one and that firms' and sectors' past experiences will influence the strategies they use today. In Mexico, where the reform programme has been in place the longest, firms have fallen back on more mature products, have abandoned or deferred plans for expansion or for specialization in new products, and have cut back on their technological activities significantly. Their Argentine and Brazilian counterparts, which are dealing with more recently established reforms, have taken decisions in the short run that would seem to put them on the same path. In none of the three cases has there been, at least thus far, large-scale closure of plants or a changeover to strategies based primarily on the marketing of imported goods.

I

Introduction

Recent case studies conducted in Argentina, Brazil and Mexico –by Chudnovsky, López and Porta (1992), Erber and Vermulm (1992) and Unger, Saldaña, Jasso and Durand (1992), respectively– have all used a similar methodology to analyse how the structural adjustment processes launched by these countries in 1982 in response to the external debt crisis have affected business strategies in the petrochemical and machine tool industries.¹ The purpose of this article is to discuss and compare the main findings of these three research projects as they relate to the hypotheses on which the studies were based.

Despite the relative uniformity of these three countries' macroeconomic situation and public policies in 1980-1990, their entrepreneurial behaviour patterns were expected to differ. The researchers hoped to identify the numerous determinants of microeconomic behaviour and to ascertain how these factors interacted. It was thought that the explanation for the various types of different business strategies was to be found not only in the particular features and characteristics of each firm, but also in the structural pattern of the corresponding industrial sector and in the prevailing form of macroeconomic regulation.

The study focused on one sector that produces widely used inputs and one capital goods sector. The techno-economic and market configurations of these two sectors were very different, as also were the characteristics of a "typical" firm in each of the sectors. In the petrochemical industry, companies belonging to large national economic groups and subsidiaries or affiliates of transnational corporations

predominate. In the machine tools industry, on the other hand, most of the firms operate on a small or medium scale and, even in the case of some subsidiaries of transnational corporations, exhibit a decision-making structure that is based on the personality of the owner or of immediate family members (usually European immigrants or their first-generation descendants). The first-named sector's greater financial capacity, strategic planning capabilities and lobbying strength, along with other comparative advantages, enable it to process exogenous signals more successfully.

The study analysed the entrepreneurial strategies followed during two periods marked by very different macroeconomic and economic policy configurations: (i) the stage of external and fiscal adjustment that began with the 1982 debt crisis; and (ii) the stage of structural reform (liberalization, deregulation, privatization) that began in the second half of the 1980s in Mexico and in the 1990s in Argentina and Brazil.

During the first of these stages, the high inflation rates, recurring external crises and sluggish economic growth seen in the 1980s led to low levels of private investment and the increasingly widespread use of survival strategies. According to orthodox theory, since these were closed economies, firms could not be expected to be technologically innovative or to raise their productivity and quality standards. None the less, as the manufacturing sector became increasingly heterogeneous, some firms actually did expand their production and export capacities and introduce new technologies during this period.

The second stage might be described as having a more competitive climate that could be expected to encourage firms to invest, renew their efforts in the field of technology, restructure obsolete operations, introduce new products and seek out new markets (Frischtak, Hadjimichael and Zachau, 1990). Earlier experiences with liberalization had shown, however, that firms had primarily exhibited defensive reactions entailing the abandonment of their own production activities and the importation of similar foreign products instead, a deterioration of production or technological capabilities, and rationalization of corporate structures (especially in terms of staff).

□This article summarizes a comparative study (Chudnovsky, López and Porta, 1993) conducted as part of a project on structural adjustment and business strategies in Argentina, Brazil and Mexico. The project, which was carried out in 1991 and 1992, was coordinated by CENIT (Buenos Aires), with the participation of Fabio Erber (BNDS, Rio de Janeiro) and Kurt Unger (CIDE, Mexico) and funding by the International Development Research Centre (IDRC) of Canada. The authors are especially grateful for the assistance provided by Martina Chidiak.

¹ In addition to compilations of the relevant literature and the analysis of secondary sources, interviews with executives of firms in these two sectors were an essential component of these research efforts.

It was more difficult to evaluate private business strategies in Argentina and Brazil because the policy changes in those countries are so recent. In the case of Mexico, however, entrepreneurial strategies could be expected to be more clearly defined, since that country's liberalization and deregulation policies have been in place for a longer time. The repetition in Argentina and Brazil of behaviour patterns observed in Mexico was another of the hypotheses to be tested. In this respect, it would be necessary to bear in mind that although these countries' adjustments and structural reforms have all been based on the same theoretical/ideological matrix, each country has conducted these processes in its own way within the context of different economic structures and different political and sociological factors.

The essentially ahistorical and atemporal approach that permeates the orthodox literature on corporate behaviour was not felt to be an appropriate means of testing these hypotheses. This approach regards business firms as institutions that take decisions on the basis of changes in market conditions and in the available stock of physical capital for the purpose of maximizing their profits. Rather than looking at business firms as an object that merely shifts from one equilibrium position to another, the present research effort used a dynamic neo-Schumpeterian approach (Dosi and others (eds.), 1988).

Using this approach, corporate decisions are seen, in part, as a legacy from the past and the circumstances prevailing at that time. When those circumstances change, new decisions will be based on an investigative process marked by uncertainty and will depend on the specific climate in which the relevant firm is operating (Nelson and Winter, 1982). Corporate decisions are, therefore, strongly influenced by the point in time and the historical context in which they are taken, as well as by the nature of the decision-making process and the way in which the firm itself is organized. As time goes on, a kind of learning process takes place and technical and commercial information and expertise are built up. This contributes to the creation of a stock of intangible assets which, depending on their quality, will guide corporate decision-making in response to new circumstances as they arise.

The specificity of the national cases covered in the study made it necessary to take two quite significant facts into consideration: first, the quantitative and qualitative differences between the endogenous

technological activity of firms in these three countries and that of firms from some developed countries; and, second, the fact that relatively less importance is attributed to production strategies than to financial enhancement or profit- or subsidy-seeking strategies.

Having thus set forth some of the premises on which the analysis of corporate behaviour was based, it is essential to make the point that these behaviour patterns cannot be understood without taking the sectoral dimension into consideration. The characteristics of the production process, the type of demand, the pace of technological change, access routes to spearhead technology, the configuration of the relevant industrial branch at the world and national levels, and the form taken by competition (price-based competition or competition extending beyond that factor) are key components of the environment in which firms define their long-term strategies.

The predominant form of sectoral regulation should also be examined. The structure and development of many industrial sectors have been based on active State involvement, and these regulatory frameworks were altered substantially during the period covered by the study. The analysis of firms' growth trajectories led to a review of the design and application of regulatory instruments in each country's particular institutional context. Sectoral structures and the specific nature of the corresponding regulations have a direct influence on entrepreneurial strategies while at the same time dampening or heightening the impact of changes in macroeconomic variables and public policy.

With regard to macroeconomic factors, one priority area of analysis was the effects of fluctuations in the main relative prices and in the levels of economic and investment activity. The way in which significant changes in commercial and industrial policy are converted into signals for short- and long-term corporate decision-making was also examined.

The analysis of the impact of public policies called for an exploration of the environment formed by society and the State and of the degree of certainty existing among private agents regarding the sustainability of a given macroeconomic configuration, as well as their delayed reaction to changes in that structure, with a distinction being drawn between short- and long-term measures. An effort was made to focus on those types of institutional matters that

affect the way in which the market –especially in sectors dominated by large economic groups– interacts with the State, as the voice and supposed representative of the public interest, during a period of fiscal crisis in which a liberal ideology is rapidly gaining ground.

Section II of this article presents a comparison of current corporate strategies and evaluates a number of decisive factors. Section III contains an analysis of

past corporate and sectoral events within the context of the policies that predominated in the 1980s, since this background information is essential to an understanding of present strategies. The changes that have occurred over time in the macroeconomic and institutional situations and their effect on business decisions are explored in section IV, and finally, in section V, the study's chief findings are analysed in the light of the questions posed at the outset.²

II

Business firms and structural reform

In all three countries, the outlook for firms in these two sectors in terms of corporate profits is less bright than before owing to the international recession, the countries' macroeconomic situation and the implementation of structural reforms. The firms' response has been a defensive one and has included the suspension of investment projects, staff cuts, the downscaling of management structures and decreased expenditure on both in-house and outside technological activities.

1. Mexico

Mexico has been implementing its reforms, applying price stabilization measures and striving to achieve macroeconomic equilibria for a longer period of time than the other two countries. The consolidation of its deregulation and liberalization policies and, above all, its free trade agreement with the United States and Canada, have reduced the level of uncertainty for business enterprises, and within this context, corporate strategies in Mexico appear to be more definite and clear-cut than in Argentina and Brazil.³

Mexican companies in these two sectors have tended to consolidate and increase their activities in the more mature production segments or product lines in an attempt to defend their oligopolistic market position (petrochemicals) or their location-related advantages (machine tools). They have also cut back on the scope and level of their technological efforts.

This orientation in the business strategies studied in Mexico is closely connected with the consequences of nearly a decade of recession and sluggish investment. The liberalization policies and efforts to re-establish links with the international economy which, in this case, were undertaken early on, did help stabilize the situation in terms of the outlook for business firms, but they also prompted companies to adopt a predominantly defensive stance which was a far cry from the aggressive action in the areas of technology and investment that greater exposure to international competition would supposedly foster.

Will this turn out to be a looking-glass in which we can foretell the as yet relatively undefined trends in corporate behaviour in Argentina and Brazil? The characteristics and consequences of the macroeconomic adjustments made by these two countries in the 1980s were, generally speaking, similar to those seen in Mexico. The orientation of recent structural reform policies and the main policy tools likely to be used in this regard are also fairly similar. In all three countries, although there may be differences of degree, these reforms represent a sharp break with previous protectionist policies.

The developing countries (and their business firms) have little or no chance of playing an active role in defining the sectoral parameters for

² Except where otherwise stated, the information and concepts presented in relation to each country were drawn from the case study on that country.

³ Although these two industrial sectors are representative of the prevailing situation for industries producing widely-used inputs and mechanical capital goods, the statements made here should not be regarded as applicable to other branches of manufacturing industry in the countries covered by the study. Research now under way in Argentina and Brazil does, however, suggest that the trends in some other industrial sectors (including some consumer goods producers) are similar.

competition, however. The production and demand structures, the dynamics of technical progress and the relevant sectors' forms of internationalization are externally-determined conditions that offer a limited measure of manoeuvring room for Argentine, Brazilian and Mexican firms.

Consequently, the macroeconomic framework, public policy configuration and structural factors affecting these sectors are similar in all three cases. It is reasonable to believe that the two sectors' strategies of "digging in" in relatively mature segments of the market where there is less competition will be repeated in Brazil and Argentina. Studies conducted in those countries have indeed found that businesses are adopting survival strategies involving the abandonment of investment projects and the implementation of adjustments designed to "streamline" payrolls and operational structures.

There is no evidence that companies are moving along a path of technological innovation in either of the two industries. Innovative activities by large local firms and subsidiaries of transnationals in the petrochemical industry were very limited throughout the period studied.⁴ In the machine tools sector, during the 1980s Argentine and Brazilian firms that had developed their own design capabilities took advantage of opportunities for copying technologies to move into the development of CNC (computerized numerically-controlled) machine tools, although they lagged somewhat behind the international leaders. In any event, the persistence of depressed markets and the steps taken to open up the economy have had a marked effect on this more innovative course of action.

The past history of these branches of industry and, in particular, of the business enterprises covered by the study has not, however, been similar in the three countries. Nor are their specific modes of micro-macroeconomic linkage the same. These differing circumstances generate some degree of freedom in this regard, so that, despite their relatively similar macroeconomic and sectoral frameworks, the paths chosen by firms in the three countries may tend to diverge in the future. Furthermore, the specific ways in which the structural reform and adjustment processes are being carried out, as well as their

sociopolitical contexts, exhibit individual features in each of the three cases. It can therefore not be ruled out that the business enterprises studied in Brazil and –with less probability– in Argentina may follow a different path from that taken by the Mexican companies.

2. Structural factors

The model for the establishment and development of the petrochemical industry was based on a high degree of direct involvement of the State in the upstream stages and of private enterprises (primarily monopolies and single-item producers) in each successive downstream phase. This public-private linkage reproduced, albeit with a greater degree of entrepreneurial fragmentation, the scheme of vertical integration and large-scale operations that predominates at the international level, and it enabled this industry to share in the distribution of primary income. The new regulatory framework that has accompanied structural reform makes it necessary to carry out changes if these three countries are to maintain that sectoral scheme.

Because of the reduction in the level of State involvement in the production of hydrocarbons and petrochemicals and the deregulation of raw material prices in the sector, the petrochemical production chain needs to be redefined in order to ensure a supply of inputs and to internalize the primary-income transfer/competition process. The future development of this activity will require a changeover from a model of vertical integration within this branch of industry (the petrochemical pole) to a scheme of intra-firm vertical integration. The particular forms that this transition takes on in each country will depend on the extent to which the State moves out of the production of inputs (completely in the case of Argentina, partially in those of Mexico and Brazil) and on the corresponding entrepreneurial configurations.

In Argentina, the regulatory apparatus that was in place until the late 1980s has now been dismantled, and the State has withdrawn from the production of hydrocarbons. In Brazil, reforms have moved forward more slowly, and promotion mechanisms have been cut back but not eliminated; for example, PETROBRAS, the State oil company, still maintains a subsidized price for gasoline sales to the petrochemical industry. Mexico's government oil company,

⁴ Local firms do appear to have made a greater effort to gain technological expertise, within the narrow confines of the characteristics and relative stability of this industry's technological paradigm.

PEMEX, still accounts for a large percentage of petrochemical output, although it has begun to withdraw from downstream production activities. The Mexican State still works to promote the development of the petrochemical industry in that it maintains some subsidies for the sale of raw materials and intermediate products. In any event, in all three countries the prices of petrochemical raw materials have risen, and at the same time the lowered levels of protection have tended to bring domestic prices for final petrochemical products into line with international prices.

Firms have responded to the prospect of smaller profits with defensive action, abandoning investment plans and laying off workers. They have continued along a "natural" process optimization path, but are relying much more heavily on the type of expertise gained through hands-on operations than on systematic research and development efforts. Probably because of the larger size of their domestic markets, firms in Brazil and Mexico seem more interested in developing new applications for their products than do their Argentine counterparts, but they too have de-activated specialty-production projects that were in their early stages.

Meanwhile, some companies belonging to large economic groups have begun to formulate longer-term strategies that include vertically integrated operations; this has been made possible primarily by the privatization of the relevant enterprises. These operations tend to be directed "backward" in Argentina and Brazil and "forward" in Mexico, with the difference being due to the specific characteristics of these countries' regulatory frameworks.

Clearly, until such time as a new stage of rapid growth appears to be in the offing in one of these three countries, the redefinition of this industry's technical/corporate structure will tend to move in the direction of a greater concentration of capital and of supply, which works to the benefit of some of the established private producers. A firm's ability to take a more active role in this process will hinge upon the relevant conglomerate's flow of resources, the relative buoyancy of the sub-market in which it operates, and the firm's chances of gaining access to suppliers of technologies. These new "winners" seem to be more clearly defined in Mexico and Argentina than in Brazil, where the reform process is less advanced and the network of business relationships associated with the previous model appears to be more rigid, thus hindering vertical integration.

An examination of the petrochemical industry illustrates how the sector's structural factors (its international logic and national regulation) influence the viable alternatives for private strategies. Owing to the characteristics and relative stability of the sector's technological paradigm, the existing range of technological options was quite limited. At the same time (given the relative size of the firms), the fact that Latin American companies could afford to spend much less on research and development than the leading firms in the international marketplace ruled out any major innovations in processes or products. On the other hand, in order for projects involving mature products and relatively widespread technologies to have a satisfactory commercial outcome, it was necessary for these firms to engage in an operational learning process that included routine technological activities.

So long as national regulation supplanted the logic of intra-firm vertical integration with public-private linkages within this branch of industry, local production activities were provided with a very high level of protection, which limited competition in the domestic market. The narrowness of their technological path and the broad scope of regulatory mechanisms left no room for any substantial degree of differentiation in business strategies.

The changes made in the regulatory framework have led to a re-working of corporate strategies, even in cases where technological factors have not been altered in any significant way, but they do not necessarily entail major differences in current business decisions. Specifically, technological/production upgrade strategies are still conspicuous by their absence. Be that as it may, in order to remain in business firms must make an active effort to move towards greater vertical integration. Their chances of being relatively successful in this (i.e., in comparison with other producers) will depend primarily on their ability to compete in the privatization process.

The technological path open to established firms is tending to narrow even further. On the one hand, more intense competition in domestic markets boosts the minimum level of technological activity necessary to ensure a firm's continued existence. On the other, spending cuts in this area limit the level of technological training as well as the chances of introducing improvements in processes or products. Although a firm's survival will probably not be threatened in the short run, over the long term its ability to select

and absorb technologies for possible future investment will diminish. What is more, in the cases of Mexico and Brazil it has been found that the conditions under which firms are able to gain access to outside technologies have worsened since the late 1980s.

The machine tools industry's structural determinants are different and, as a result, a greater degree of differentiation was seen among the strategies of firms in this sector than in the petrochemical industry during the period in question. The structural reforms now under way would also appear to pose a greater threat to the continuation of the bolder sorts of corporate technological/production strategies. From the standpoint of the sectoral configuration, the effects on the machine tools industry appear to be leading in the direction of a marked deterioration in production and a widening technological gap between these nations and the developed countries.

In the countries studied, this industry was affected by two different trends during the 1980s. On the one hand, a new production paradigm—based on the incorporation of CNC tools—came into widespread use, thereby ushering in a new generation of products and production processes in this branch of industry. On the other hand, the recession—which had a particularly serious impact on investment-weakened demand for the output of this sector in particular. The combination of these two factors generated a complex set of circumstances in which the industry's technological momentum carried it in the direction of offensive strategies while its dwindling market prompted defensive measures.

Unlike the situation in the petrochemical industry, neither Mexico nor Argentina had a specific regulatory apparatus that could have altered the depressive signals generated by the prevailing macroeconomic conditions, although Argentine companies did benefit from the preferential access to the Brazilian market (which was booming in the period 1985-1989) that they received under a binational capital goods integration agreement. In contrast, however, even without any special promotion scheme such as that implemented for the petrochemical industry, Brazilian firms were able to obtain financing on preferential terms and enjoyed a relatively higher level of protection from imports.

In other words, the elements exerting the strongest influence on the configuration of structural factors in the machine tools industry were general macroeconomic adjustment policies and rapid changes

in the pattern of technical progress. In the 1980s the industry began to undergo a restructuring process which put an end to a recently inaugurated government programme for establishing the industry in Mexico and led to the disappearance of a large number of firms in Argentina and a somewhat smaller number in Brazil. In these two countries some companies managed—with varying results—to fit in with the new technological paradigm. Clearly, the greater flexibility of this industry's production processes, the possibility of copying technology and the absence of a specific regulatory framework (three significant differences between this industry and the petrochemicals sector) have permitted the deployment of more widely differentiated business strategies.

The leading market positions in Argentina and Brazil have been held by companies that have incorporated a substantial proportion of CNC machine tools into their product mix. All of these companies had previously acquired a considerable amount of experience in product and process engineering and, except in the case of one Argentine firm whose subsequent growth was seriously weakened, all these companies gained access to the new paradigm through links (of ownership or through licensing arrangements) with leading enterprises at the international level. Brazilian firms' relatively higher level of development appears to be due to their earlier entry into commercial production of CNC machine tools, their greater size, their status as subsidiaries or affiliates of transnational corporations (in three out of the four cases identified), a comparatively less recessionary macroeconomic configuration, strong protection against imports and the continuation of some promotional mechanisms for financing sales.

Vertical integration and the wider spread of products exceeding international standards—trends which became more marked in the context of the uncertainty and instability of the 1980s—had already been restricting the development of these companies within the new paradigm. Although leading Brazilian firms are now increasing their exports sharply (with their competitive position tending to be based on the use of conventional equipment and better access to marketing networks by virtue of their status as foreign firms), the recessionary conditions existing in the domestic market are making it more difficult to sustain these leadership strategies. Access to less expensive imported components is, on the other hand, a potentially favourable factor, and Brazilian firms

claim they do not feel threatened by competition from imported CNC machine tools (which are still subject to a high tariff). Nevertheless, in response to the present economic situation, companies in this segment have considerably reduced their internal technological efforts and have cancelled investment projects.

The continued growth of Argentine firms has become particularly problematical in both regional and domestic markets owing to the combined effect of abrupt changes in the conditions relating to competition, a lagging exchange rate and a shortage of financing for domestic and foreign users, all of which has cancelled out the advantages afforded by their location and export experience. Under these conditions, plans for expansion have been suspended, production and exports have been cut back sharply, the number of employees has been considerably reduced and a large Italian corporation has taken over one of the industry's leading firms.

The build-up of inertial factors and uncertainty as to the chances of competing successfully in this

new environment have undermined leadership strategies and, hence, the possibility of at least avoiding any further widening of the gap separating the most advanced segment of the machine tools industry in these countries from the international leaders. It has also become more necessary than ever to form partnerships with foreign companies, which will bring about a significant change in the traditional entrepreneurial structure of the sector. Intermediate strategies adopted by some firms in Argentina and Brazil, which entailed a gradual upgrading of products and process technologies and more timid forays into the production of CNC machine tools, also appear to have suffered severely. The know-how learned over many years of labour, the continued existence of a substantial market for conventional machinery and the continuing importance of maintaining a direct relationship with widely scattered users account for the widespread use of fairly passive survival strategies in all three cases.

III

Prior history of the firms and sectors

In order to understand the rationale behind the recent changes in microeconomic strategies and in the industrial setup, we need to take a look at the past history of the relevant companies and sectors and to examine the specific micro/macro relationship in each case. These elements –which impose certain constraints and determine the range of possibilities for a firm's current business activities– will be analysed below.

1. The petrochemical industry

The growth rates for petrochemical output and apparent consumption in Argentina, Brazil and Mexico were far higher than those countries' GDP growth rates in 1970 and 1980 (see table 1), which indicates that petrochemicals were being substituted for traditional materials on a large scale.

Owing to the larger size of their domestic markets and their success in maintaining a rapid economic growth rate, especially during the 1970s,

the Brazilian and Mexican petrochemical industries have grown to be much larger than Argentina's (see table 2).⁵

a) *Structural characteristics*

The petrochemical industry is characterized by the predominance of mass-production processes, high capital/output and capital/labour ratios and significant effects of scale. These features give rise to highly concentrated supply patterns in producer countries, and this is especially true in the case of developing countries.

⁵ If the industry's output of synthetic fibres and fertilizers is also taken into account, then the difference between the sizes of the Brazilian and Mexican industries and that of Argentina would be even greater.

TABLE I

**Argentina, Brazil and Mexico: Annual growth rates of GDP
and of output and apparent consumption of petrochemicals^a**
(Percentages)

	GDP		Petrochemical output		Petrochemical consumption		Consumption of final petrochemical products	
	1970-1980	1980-1990	1970-1980	1980-1990	1970-1980	1980-1990	1970-1980	1980-1990
Argentina	2.6	-1.1	6.4	8.6	4.3	7.0	5.6	2.2
Brazil	8.6	1.5 ^b	27.3	4.9 ^b	22.5	3.7 ^b	15.8	3.0 ^b
Mexico	6.6	1.6	12.7	12.0	12.3	8.8	11.3	5.0

Source: Prepared by the authors on the basis of data from APLA (1988 and 1991), IDB (1991), Clemente de Oliveira (1990), Chudnovsky, López and Porta (1992), Erber and Vermulm (1992), Gutiérrez (1991) and Unger, Saldaña, Jasso and Durand (1992).

^a For purposes of this comparison, the data for the three countries have been standardized on the basis of a set universe of petrochemical products which includes primary and intermediate products, thermoplastic and thermorigid resins, elastomers and solvents. It does not include synthetic fibres, fertilizers or specialty chemicals.

^b 1980-1989.

In Argentina, Brazil and Mexico, average plant size has increased as the industrialization process has progressed, although in the beginning the plants were constructed on a small scale to fit the domestic market. By the 1970s, however, the plants being opened in Brazil and Mexico were built on an internationally efficient scale. In Argentina, this size transition was more uneven and was not completed until the 1980s. Plant size in all three countries is now being brought into line with optimum international levels.

Progress has been made in all three countries in the construction of integrated petrochemical complexes or poles in which the State has generally controlled the production of raw materials; these complexes have served as substitutes for the high degree of vertical integration of the large petrochemical transnationals in developed countries.⁶ In Brazil, this trend has been even more generalized, and three great poles have been built which exhibit high-density input/output flows and are almost wholly self-sufficient in terms of supply.

⁶ The importance of economies of scale, the fact that the most commonly used processes generate co-products, and the high cost and risk of transporting some products justify a high degree of technical integration in the petrochemicals industry. In developed countries the main producers also display a high degree of vertical integration, which gives them significant comparative advantages (transfer prices, guaranteed supply, etc.).

In Argentina, the construction of two major integrated petrochemical complexes was carried forward in the late 1960s, but private investors' withdrawals or delays gave rise to imbalances in input/output flows which have yet to be fully corrected and have led to large export and import flows of basic products (see table 3). As a result, the production structure is insufficiently integrated, and many branches of the petrochemical "tree" are still missing, a particularly noteworthy example being that of intermediaries for fibre products.

Mexico is situated between these two extremes. It has placed less emphasis on the construction of integrated complexes than Brazil (the most modern of the PEMEX plants come closest to fitting in with the idea of poles). As in Argentina, the industry suffers from some imbalances in the sectoral input/output chain, which is reflected in rather high import coefficients (although these figures were moving downward throughout the 1980s). Much of the responsibility for the disjointed nature of the input/output chains may be attributed to the suspension by PEMEX of investments which it should have made during that decade in primary and intermediate product segments.

Although exports were the most dynamic demand factor in all three countries in the 1980s, they were not a growth leader. Most of the plants were designed with import substitution in mind, and exports were merely a response to the fact that local demand was lower than expected. Without them, the cost and productivity advantages afforded by the

TABLE 2

**Argentina, Brazil and Mexico: Output, foreign trade and
apparent consumption of petrochemicals, 1990**
(Thousands of tons)

	Output	Imports	Exports	Apparent consumption
Argentina	2 299.4	289.8	576.3	2 012.9
Brazil ^a	10 138.5	277.9	1 107.3	9 309.1
Mexico	10 459.7	1 129.7	1 535.6	10 051.9

Source: Prepared by the authors on the basis of data from APLA (1988 and 1991), IDB (1991), Clemente de Oliveira (1990), Chudnovsky, López and Porta (1992), Erber and Vermulm (1992), Gutiérrez (1991) and Unger, Saldaña, Jasso and Durand (1992).

^a 1989.

construction of international-scale plants would have been undermined by high levels of idle capacity. Thus, in addition to performing a counter-cyclical role, exports have also been a response to the slowing of domestic growth in the three countries during the 1980s.⁷ In any event, taking into consideration their experiences during that decade, the strategies of all the firms which were interviewed provide for a continuing flow of exports as a means of maintaining some degree of market diversification.

b) Regulatory frameworks and types of companies

In the 1970s and 1980s, the petrochemical industry received a heavy flow of private and public investment in these three countries; indeed, during the latter decade this flow contrasted sharply with the decline in total investment rates. One of the reasons for this is the amount of time that elapses between the moment when an investment decision is taken and the opening of the plant. Another key factor is the presence of generous government inducements.

Investment costs in this industry are high, and project lead times are quite long. The situation tends to be worse in developing countries due to longer construction times, defective infrastructure and higher machinery and equipment costs.

Because of the need to make up for these disadvantages, which are compounded by the greater difficulty of obtaining credit, it has become usual in developing countries for the Government to use various instruments to promote capital formation, as has

been the case in the three countries analysed here. There is reason to believe that, if it had not been for these sectoral promotion mechanisms, no more than a small part of the investments made in these three countries would actually have been carried out.

These systems of incentives appear to have been most generous (as well as involving a considerable degree of redundancy) in Argentina and Brazil, where the extension of credit on preferential terms –as was also done in Mexico– was coupled with very attractive fiscal promotion policies which meant that the capital actually invested by private enterprises was a minority share of the total investment in each case. The objective of these incentives was to promote the construction of plants to produce import substitutes. The only *quid pro quo* in these public policies was a requirement that the plants should at least attain a certain minimum scale and, in Brazil, a requirement that a certain amount of equipment and technology for the plants to be constructed had to come from domestic suppliers, together with disclosure requirements regarding foreign partners' technology packages.

Given the importance of hydrocarbons in the sector's cost structure, all three countries have maintained preferential pricing systems for hydrocarbons to be used in the petrochemical industry; the benefits from this system have tended to be concentrated at the point of the industrial processing of these materials, thereby transferring to petrochemicals producers the financial benefits obtained from the extraction and production of fuels. In Brazil, the supply of raw materials at subsidized prices has been counterbalanced by the establishment of price controls that limit producers' profit margins; this transfers the subsidies to users and prevents local prices from rising too far above the international level.

⁷ The highest export coefficient for the petrochemical industry is to be observed in Argentina, which experienced the most notable slowdown in growth (see table 3).

TABLE 3

Argentina, Brazil and Mexico: Petrochemical export and import coefficients, in physical volumes, 1980 and 1990
(Percentages)

	1980		1990	
	Exports/output	Imports/apparent consumption	Exports/output	Imports/apparent consumption
Argentina	25.8	26.5	25.1	14.4
Brazil	3.4	6.2	10.9 ^a	3.0 ^a
Mexico	6.0	26.7	14.7	11.2

Source: Prepared by the authors on the basis of data from APLA (1988 and 1991), IDB (1991), Clemente de Oliveira (1990), Chudnovsky, López and Porta (1992), Erber and Vermulm (1992), Gutiérrez (1991) and Unger, Saldaña, Jasso and Durand (1992).

^a These data refer to 1989.

In Argentina, price controls have also been used, but State-owned primary commodity producers (regardless of whether the State owns the firm outright or is simply the majority shareholder) have not passed on the savings from lower input prices; as a result, even though the producers of final goods are working with profit margins similar to those of Brazilian firms, they have taken advantage of protection mechanisms to charge prices far above international levels. Mexico has also subsidized raw materials used by the private sector (tied to export and employment targets) but has been unable, except in a few cases, to bring the domestic prices of final goods into line with international prices.

Another significant factor has been the existence of tariff and non-tariff protection mechanisms. The range of protection was used most fully in Argentina and Mexico, while in Brazil there appears to have been a certain amount of redundancy (owing to the simultaneous existence of price controls). The possibility of price-based discrimination between the local and external markets has constituted a source of very considerable implicit export subsidies in Argentina and Mexico. In Brazil, on the other hand, explicit promotion mechanisms have been more influential. Be that as it may, in all three countries the rapid growth of exports during the 1980s can be accounted for primarily by their domestic recessions and the high levels of international prices observed during the second half of that decade.

Brazil appears to exhibit greater consistency and coordination in regard to the Government's various policy instruments for this sector. The Brazilian Government has not only helped to generate both supply and demand at the same time and has fostered

the formation of a corps of national entrepreneurs (as has also been done in Argentina and Mexico) but also, through the Industrial Development Council, has designed a policy for structuring the sector within the framework of its overall industrialization strategy.

The three countries' State hydrocarbons enterprises have made inroads, either on their own or through subsidiaries, in the petrochemical industry. Their involvement in the industry has taken different forms, however. PEMEX has controlled most of the petrochemical production chain, including intermediate and final products, while transferring income via subsidized prices. In Brazil, PETROQUISA (a subsidiary of PETROBRAS) has also participated in various segments of the chain, usually in partnership with private firms, but does not seem to have followed any group strategy. The State-run suppliers of hydrocarbons in Argentina –Yacimientos Petrolíferos Fiscales (YPF) and Gas del Estado (GDE)– have participated in the construction of the country's two major primary production plants, but it was the Military Production Bureau (DGFM) which appears to have been in charge of sectoral planning.

The most salient aspect of this comparative analysis is that, unlike the situation in Brazil and Mexico, in Argentina the State oil and gas companies' involvement in the petrochemical industry has been more a matter of form than of fact and has been based on a private-enterprise, profit-seeking rationale in that these companies have not passed on the gains received by them in the form of subsidized raw materials.

Transnational corporations have played a pivotal role in the establishment and development of the petrochemical industry in developing countries.

Initially, their involvement took the form of direct investments to supply protected domestic markets; then, starting in the 1970s, they moved into co-investments, licensing arrangements and turnkey contracts for projects involving some level of export activity.

Transnational corporations maintain a more limited presence in Argentina than in the other two countries despite these firms' predominant role in the start-up of the industry. Although economic instability, the restrictive policies applied in the early 1970s and, in one case, a decision to abandon activities in the petrochemical industry all played a part in this partial withdrawal, the main reason for the transnationals' reduced presence is that—in contrast to what occurred in Brazil and Mexico—they have not played a major role as technology-contributing partners of local firms, perhaps because of the fairly small commercial volumes involved. They have, however, been active as licensors of technology.

In all three countries large local-capital groups have maintained a very significant—and, during the period studied, growing—presence. Another shared trait is that these conglomerates are highly diversified, with activities that extend beyond the petrochemical industry to include not only other manufacturing sectors (with or without linkages to petrochemicals) but also finance, construction, etc.⁸ These groups' size and level of integration are very limited in comparison to those of the large chemical/petrochemical transnationals, owing both to the presence of institutional constraints on efforts to move into the production of primary goods or hydrocarbons and to the small size of local markets.

The Mexican groups appear to have the highest degree of concentration in petrochemicals—mainly in final products and related manufactures, given the extensive markets reserved for PEMEX—and the most clearly-defined business strategies. In Argentina, on the other hand, revenue from this activity tends to account for a smaller portion of the conglomerates' total income and, in some cases, a specific strategy for the sector

seems to be lacking. The strategies of such groups in Brazil appear to be blocked by the highly dispersed nature of stock ownership caused by the tripartite organizational model in use in that country.⁹

c) *Technological activities*

It can be argued that there are upper and lower structural limits on possible technological strategies in this sector in developing countries. The lower limit in this case would be represented by those functions essential to the optimization of processes and the satisfactory management of production plants which must be performed in order for a business to be competitive. The upper limit would be determined by the amount of resources which the enterprise is in a position to devote to research and development. The expenditure threshold required in this industry in order to make major innovations in processes or products has been beyond the reach of local firms, and transnational corporations have simply not assigned this sort of activity to their subsidiaries in these countries.

As a result, the technological strategies of the enterprises analysed in these three countries have all been rather similar, although the types of technological activities undertaken vary depending on the product in question. In upstream segments, the emphasis has been on process optimization and energy conservation, while downstream concerns have done more work in the fields of product technology and technical assistance for customers. This has come about more or less naturally, with efforts being made in those areas necessary to a firm's market operations, and these efforts have thus established the lower limit for technological activity. The more aggressive firms with more money to spend on research and development have set themselves more ambitious goals, such as modifying process technology with the help of their own basic engineering expertise (setting up pilot plants), developing new catalysts or improving existing ones, and developing new varieties or qualities of the products they manufacture.¹⁰

⁸ Spurred by State promotion policies, these local groups moved into petrochemicals—especially in Argentina and Brazil—with almost no previous experience. As this industry has developed, they have managed to acquire their own business expertise based on their practical experience in business administration.

⁹ The State provides a majority portion of the investment and supplies raw materials; the local private sector furnishes the remainder of the investment and takes responsibility for the commercial and administrative management of the firm, while foreign enterprises participate as technology-contributing partners.

¹⁰ The upturn in exports seen in the 1980s does not appear to have spurred firms to make greater technological efforts in any of the three cases studied.

Local firms have engaged in more in-house technological activity than foreign companies have (especially in the case of those which have never had a technology-contributing partner or have lost that partner) and, at least in Argentina, have been more heavily involved in working agreements with public institutions. In Brazil, outside technological ties have been limited, and the firms that have been most active in forming such ties have been among the most ambitious in terms of technological advances. In Mexico, government research centres are held in very low esteem due to their overly bureaucratic nature.

Owing to the small size of most of the companies analysed, research and development efforts have been quite scattered. Brazilian firms appear to have attained a relatively higher degree of technological autonomy and to have formed a significant pool of know-how sufficient to guarantee the efficient operation and proper maintenance of existing facilities. Furthermore, Brazil's petrochemical industry has begun to develop and market its own technology in some fields. On average, Argentine enterprises spend the least on research and development, and the upper limit of their technological activities has therefore been the lowest; State enterprises and some small private firms appear to have been the most active in this field. Mexican firms have concentrated on making their production processes more efficient rather than on developing new products; the larger companies that spend the most on research and development have started up their own projects in an effort to make headway in technologically complex areas, such as that of specialty products.

The effective assimilation of imported technology—whether in relation to processes or basic principles—has been limited. The acquisition of know-how has focused on detailed engineering aspects (this area is less well developed in Argentina), assembly and operation. The most progress of the three appears to have been made in Brazil. Brazilian firms have undertaken projects to expand their production capacity using their own engineering expertise, have cut back on restrictive clauses and made headway in “unwrapping” the packages contained in transfer contracts, have upgraded personnel training and their participation in plant design, and have attained a better understanding of basic process principles. One contributing factor in this connection has been the Brazilian Government's policy of focusing on the development of local technological capabilities, which

provides for research and development loans, prohibits the inclusion of restrictive clauses in transfer contracts, and promotes the adoption of aggressive negotiating positions, among other measures.

In Argentina and Mexico, on the other hand, there have not been any significant sectoral policies on technological training, although (mainly as the result of an isolated event) Argentina can boast of a case in which public research institutions and a number of firms in the sector established successful linkages in the areas of technical and professional training and the provision of services and technical assistance in various fields. Argentine enterprises have been less active than their Brazilian counterparts in “unwrapping” technology contracts, and it is more usual for them (including even those firms that already have years of operational experience in the sector) to purchase turnkey facilities. The lack of any State legislation requiring petrochemical projects to use a higher percentage of local technology goes a long way towards accounting for these differences.

2. The machine tools industry

A high level of protection from imports, granted within the context of an expanding domestic market, was for many years the main impetus for the production of machine tools—in an industry developed by immigrants—in Argentina and Brazil. In Argentina, however, the opening of the economy to imports in 1978–1981 triggered the closure of many plants. Although protection was restored in 1982, the concessional financing arrangements subsequently made with Spain and Italy for the supply of equipment undermined its effect. The capital-goods integration agreement concluded with Brazil was perhaps the only exception to the general rule of very limited incentives for this industry in Argentina. Brazil, for its part, tended to generate a *de facto* reserved market by virtue of the extension of the criterion of similarity. In addition, unlike Argentine enterprises, the firms located in Brazil benefited from generous systems and mechanisms for financing their sales, at least until the late 1980s.

The history of this sector in Mexico is quite different, apparently because of its traditionally lower levels of protection and the proximity of its North American suppliers. The Government sought to promote the manufacture of machine tools by joining in various initiatives between 1975 and 1978 as a direct

participant. The government policy in this area included financing and tariff protection, as well as preferential treatment in State purchasing. For a number of reasons, however, these semi-State ventures were not successful. Given the macroeconomic conditions prevailing since 1982 and the liberalization of trade starting in the mid-1980s, few companies have been able to withstand the pressure from imports, especially of used machine tools.

Brazil is the largest machine-tool producer in Latin America. Brazilian output climbed steadily until 1980, but then plummeted during the 1981-1983 recession. Following a steady recovery which, by 1988, had raised the production volume above the peak level recorded at the start of the decade, it slumped once again, with 1990 sales amounting to US\$314 million as opposed to US\$628 million in 1988. Argentina reached its highest production level in 1978, but then lapsed into a downswing until 1984, followed by an upturn that lasted until 1988, when the value of output amounted to US\$48 million (far less than in 1978). The subsequent recession pulled production down to only US\$30 million in 1991. In Mexico, the value of the industry's output plunged from a high of US\$96 million in 1982 to only US\$33 million in 1987.

In contrast with Argentina and Mexico, Brazil's industry has been fairly closed to international trade, although some changes have been made in recent years.¹¹ The export coefficient for Brazilian output averaged less than 5% in 1985-1989 but rose to 14% by 1990, while the import coefficient increased from 10% in 1985-1986 to 44% in 1990. In Argentina, the export coefficient for 1986-1990 was 55% and the import coefficient was 63%. In Mexico, imports have been covering between 80% and 90% of apparent consumption while exports are undertaken on a fairly considerable scale.

a) *Structural features and types of companies*

Small and medium-sized enterprises dominate machine-tool production in Argentina, Brazil and Mexico, although in Brazil there are some exceptions.

In the late 1980s, the leading firm employed 2 000 people and was invoicing nearly US\$100 million. In contrast, the largest Argentine company provided jobs for only 320 persons and invoiced US\$10 million in 1988.

Although the copying of technology is a very common form of absorption in this industry, the obtaining of manufacturing licenses, co-investments and, to a lesser extent, foreign direct investment (FDI) have been gaining in importance. Nevertheless, FDI has reached significant levels only in Brazil, which witnessed the establishment of a number of German firms in the 1960s in line with the growth of the subsidiaries of various motor vehicle manufacturers.

In an industry where technological change is an inherent part of its growth dynamics and international deployment, technological progress has been picking up speed ever since the mid-1970s as a result of advances in the field of microelectronics. The most visible manifestation of this trend has been the incorporation of numerical control (NC) technologies. This innovation, which made it possible to bring the advantages of automation to what had, until that time, been the inaccessible area of small-batch production, was devised in the United States in the 1950s. With the incorporation of microcomputers into control units and their conversion to computerized numerical control (CNC), this technology began to spread rapidly from 1975 on.

Although the manufacture of numerically-controlled machine tools in Brazil dates back to 1973, it was not until the second half of the 1980s that CNC production volumes rose above 1 000 units per year. In 1989, CNC machine tools represented 44% of total sales of lathes or milling machines. In Argentina, local production of CNC machine tools began in 1979 and, after several years of very small production volumes (between 8 and 13 units), in 1987 output reached 100 units (of which 77 were exported), representing a quarter of the total value of the machine tools produced. In Mexico, even though imported CNC machine tools are quite widespread, their production has not reached significant volumes. At all events, during the 1980s most of the markets in these three countries were oriented towards conventional types of machine tools, and most of the firms covered by this study specialized in that area.

Economies of scale have not been a very influential factor in the manufacture of conventional machine tools, although their importance has

¹¹ The internationally tradeable proportion of this industry's output is high and continues to climb. Between 1970 and 1990, its worldwide export coefficient rose from 36% to 47%, while the imported supply coefficient in countries which were themselves producers increased from 31% to 41%.

increased in the production of CNC machine tools. Economies of specialization, on the other hand, are indeed significant in this industry and are found not only in final production processes but are also a hallmark of the vertical de-integration often observed in this industry in developed countries.

Unlike the situation in those countries, the manufacture of machine tools in Brazil exhibits a high degree of national and vertical integration and of diversification in production. The market-reserve policy that has been in place in the informatics sector since 1982 has encouraged the domestic production of CNC machine tools and this, in turn, has increased the level of national integration; indeed, the leading producer (which has been self-sufficient in CNC units) has augmented the vertical integration of its production activities. Although Argentine plants are less vertically integrated and less diversified than Brazilian facilities, they have been hurt by a lack of part and component suppliers and by their scant economies of specialization. Mexican plants, for their part, are quite diversified and, with some exceptions, display little vertical integration due to the type and local content of the machine tools they manufacture.

b) *Production and technological strategies*

Unlike the petrochemical industry, this sector has deployed a whole range of business strategies, especially in Argentina and Brazil. The main reason for this difference between the two sectors lies in the dynamics of technological change, the access routes to it, and the greater rigidity of the petrochemical industry's production process and regulatory framework. In the machine tools industry, the incorporation of CNC tools reshaped its products and processes while at the same time erecting higher barriers to the entry of companies which sought to undertake their production later on, but there were nevertheless still many opportunities for using conventional machinery. Within this context, producers of machine tools had more leeway, from a technical standpoint, in choosing among various production options than their counterparts in the petrochemical industry did.

On the basis of a comparative analysis, the companies studied can be placed in one of three categories. The first is made up of firms which have followed a leadership strategy, won a significant share of the market and pioneered the introduction

and manufacture of CNC machine tools on a commercial scale. The second includes firms which have allocated resources for the purpose of updating their product and process technology but are farther away from attaining international standards than the leading firms are and have been slower to embark upon the production of CNC machine tools. Companies that have followed a relatively passive survival strategy form the third category.¹²

The fact that three of the Brazilian firms that have followed a leadership strategy were able to count on a supply of technological inputs from their overseas headquarters or foreign partners underscores the importance of this technology access route. The other locally-owned Brazilian company in this category took a giant technological leap forward in product and process engineering in 1986 with the help of foreign licenses. One of the Argentine companies used a similar procedure in 1983 to obtain product-related technology. The other Argentine firm, in contrast, is the only one to have followed through with the strategy of relying on its own efforts; this decision is due entirely to the personal views of the owner.

All of these firms have, in addition to investing heavily during the second half of the 1980s, allocated a substantial level of resources to personnel training in the fields of production and design. The technological efforts made by the locally-owned Brazilian enterprise and by the Argentine firm that has managed to progress on its own have, however, been greater than those of their competitors in the two countries.

The upswing in the Brazilian market starting in 1984 created a favourable environment for these companies' activities. The Argentine firms also benefited from these circumstances thanks to the integration agreement which had entered into effect for these products in 1986. The subsequent recession and the reduction in the supply of financing for sales

¹² The first category includes four Brazilian enterprises (of which two are foreign subsidiaries, one is a semi-public company and the other is Brazilian-owned) and two locally-owned Argentine firms. The second category is formed by five companies in Brazil (of which one is foreign) and three in Argentina. The third category includes all the Mexican firms that were studied, four Argentine companies and five Brazilian enterprises.

caused these firms to halt their investments and cut back on staff, including personnel assigned to technological activities. A similar, although less marked, trend was to be observed among the Brazilian companies that were following leadership strategies.

The Brazilian firms in the second category (all of which are medium-sized, except for one small company) began to produce CNC machine tools between 1985 and 1988. The two small Argentine manufacturers of conventional milling machines in this group began to produce their first CNC equipment between 1986 and 1990. Another small Argentine producer of high-speed presses has also automated its machine tools. These Argentine firms are notable for having upgraded their product and process technology and made investments to expand their capacity in the late 1980s.

Three of the four locally-owned Brazilian companies in this group tried to obtain licenses in order to progress in CNC technology but were unsuccessful. One firm decided to develop its own technology, while the other two chose to mount joint ventures with a foreign partner. The Argentine firms, in contrast, did not seek licenses.

One of the differences between the Argentine and Brazilian enterprises in this category is that the former are not yet producing CNC equipment on a significant commercial scale. Even the Brazilian firms in this field have made sales only in the domestic market, however. Another major difference is that the Brazilian companies have managed to cut costs with the help of process innovations such as manufacturing cells, just-in-time production and computerization. These innovations, which require relatively small investments, were achieved mainly with the assistance of local consultancy firms. As in the case of the firms in the first category, all the companies in this group have reduced their staff engaged in technological activities and have abandoned work on products that were still on the drawing board.

The fact of operating in markets where location-related advantages seem to be of importance (e.g., where there are technical or vocational schools, small machine shops or sugar mills), the controls on wage hikes in place since 1987 and the need for (or strong commitment with) these manufacturers have all contributed to the survival of the Mexican firms.

Machine-tool manufacturers using stamping-type processes have survived by modifying their product lines and reducing the level of national content (in the case of presses). Manufacturers of lathes or milling machines and of tools for such machines have made some investments and have incorporated CNC machine tools without altering their line of products, but they have reduced the percentage of national content and increased their customer services.

The four Argentine companies in this category have employed fairly active, rather than passive, survival strategies and have sought to improve their product technology.¹³ Generally speaking, they registered high export coefficients during the second half of the 1980s, but they did not invest in expanding their capacity, nor did they modify their process technology. Their competitive position has been based on their specialization in conventional machinery and in the adaptation of products to specific user needs, but these designs—generally devised by the owner—have not been included in the firms' production costs.

Four small and medium-sized firms that employed passive survival strategies during the 1980s were identified in Brazil. These companies produce for the domestic market (none of them exports) on a highly diversified and vertically integrated basis. In response to the economic slump of recent years, all such firms—in all three countries—laid off employees. One effect of their specialization in conventional machine tools seems to be a lower degree of exposure than other firms to the effects of trade liberalization measures.

¹³ It is important to bear in mind that the Argentine study did not cover those establishments which survived the 1980s without changing their product lines, by going into the repair or servicing of machinery.

IV

The macroeconomic environment and public policy

The configuration of structural factors that shape the context for corporate strategies exhibits some significant differences between the two sectors as well as considerable similarities among the three economies during the period in question. The structure of production and demand, the dynamics of technical progress, the predominant forms of internationalization, the characteristics of a typical firm and the internalization of these elements in sectoral regulations account, in large part, for the different paths taken by these two sectors and their repetition in the three national economies considered. At the same time, the particular features of the regulatory framework in each country and of macroeconomic and institutional trends, intertwined as they are with the history of each firm and sector, help to account for the differences found within the same sector in the three countries.

1. The crisis of the developmentalist State

The 1980s were a time of crisis for the developmentalist State in all three countries. In the course of more than 40 years of industrial development based primarily on import substitution and the growth of the domestic market, the State came to play a very large and direct role in the production apparatus and to occupy a leadership position in investment and capital formation; from that position it deployed an enormous array of regulatory instruments aimed at the promotion of economic activities while retaining the capacity to arbitrate and intervene in distributive conflicts via the pricing system and the fiscal budget. Social practices have invariably been determined by reference to this decisive capacity for intervention.

At the same time, a quite diversified industrial apparatus was being set up which included basic industry and capital goods sectors. This process reached its height in Brazil in the late 1970s. Within this context, a number of disequilibria began to build up in this substitution-based development process which tended to be manifested primarily in periodic

balance-of-payments crises in Mexico, outbreaks of inflation in Brazil, and a combination of the two in Argentina. The consequences of the countries' external borrowing in the mid-1970s –summed up in the appearance as from 1981 of ongoing fiscal and external constraints equivalent to an estimated range of from 5 to 10 points of GDP– signalled the breakdown of the model and of the effectiveness of developmentalist institutions.

Ironically, one of the essential factors in these three economies' ability to cope with the corresponding external adjustment was the fruition of the major investment projects undertaken in the industrial and energy sectors during the closing stage of substitution-based promotional efforts. These projects, whose design had been based on the estimates of domestic-market growth made in the 1970s, were then redirected towards external markets. The process was accompanied by steep devaluations that gave rise to abrupt changes in relative prices. A shaky fiscal position –with spending pressures on the rise and inefficient, regressive collection structures– gave rise to a persistent demonetization process.

The fiscal situation not only weakened the currency but also squeezed public investment and reduced the range of opportunities for using direct incentives for private investment. A self-perpetuating pattern of high inflation appeared, while exchange and monetary policies grew increasingly ineffective. The economic agents anticipated this crisis, placing priority on mechanisms for making financial gains and other speculative operations and thereby further undermining the State's already very limited mechanisms for intervention.

In each of the three countries the crisis of the State and the relationship between it and the various elements of society took on different forms. In Argentina, the pattern of income distribution began to undergo a radical change in 1976 which put an end to the extensive growth pattern that had characterized the domestic market. At the same time, the

centralization of capital accelerated with the foundation and consolidation of a relatively small number of economic/financial conglomerates whose privileged relationship with the State gave them a greater ability to generate and appropriate surpluses. This process quickly led to the demise of a relatively more balanced social configuration and weakened the industrialization agenda. The adjustment of the 1980s functioned on the same basis, as it intensified pre-existing trends. At the same time, hyperinflation reflected the breakdown of the State and paved the way for far-reaching changes in the economic/social regulatory pattern.

Brazil, on the other hand, embarked on its adjustment immediately following a large-scale, State-led investment programme which (literally) completed the construction of the country's industrial matrix, promoted a better energy balance, increased the country's agricultural production capacity and generated new components of exportable supply. At its height (in the 1970s), economic growth was proceeding at a spectacular pace, and the eventual solution of problems of social inequity was equated with the continuation of this growth rate. Under these circumstances, the adjustment was seen as an essential, but necessarily temporary, measure to deal with the external shock faced by the country. Social demands for growth continued to carry a high priority—even higher than that of stability—and industrialization continued to be regarded as the best way of achieving it.

The Mexican State was not able to escape the crisis but, thanks in part to its status as the owner and direct exporter of large amounts of petroleum, its macroeconomic management of the adjustment was more successful. Along with other factors associated with the country's political and social structure, this appears to have given it a greater relative degree of autonomy, which would also explain how it was able to triumph over the expected kinds of resistance from within and thus institute structural reforms earlier on than the other two countries. The country's close economic and political ties with the United States also seem to have played a pivotal role in making it possible to implement the recommendations of the Washington Consensus in the midst of this crisis. Likewise, the subsequent negotiations regarding the North American Free Trade Agreement (NAFTA) also helped to consolidate the reform programme.

These differences—which arise out of the socio-State matrix of each of the three countries—are

expressed in the debate regarding these issues and in mainstream positions on industrial policy. In Argentina, economic policy priorities were ultimately focused on price stability and complete deregulation of the market, while approaches involving intervention in mercantile resource-allocation mechanisms were abandoned. In practice, the lack of selectivity tended to accentuate the economic concentration process. Although big business openly declared its ideological commitment to the new regulatory scheme set up as part of the reform process, investment in sectors producing internationally tradable goods has still not revived.

The predominance of the "industrialist culture" and persistent demands for more growth have been reflected, to some extent, in Brazil's structural adjustment programmes. This is reflected in a greater degree of graduality and a less thorough-going liberalization of trade, as well as in the formulation of explicit policies regarding the promotion of technological development, the enhancement of business firms' endogenous competitive position, and support for export activity. The failure to rectify the macroeconomic disequilibria, however, makes it more difficult to finance these promotional instruments and introduces an element of uncertainty regarding the future course of industrial policy.

In Mexico, the industrial policy debate is set against the backdrop of the implementation of NAFTA, which supersedes whatever selective strategy the Government might have. This has not, however, led to such an intensively market-oriented policy package as in Argentina. There are at least three pieces of evidence to back up this statement: i) the presence of well-established mechanisms for macroeconomically-based negotiations with employers and trade unions; ii) the continued existence of some internal regulatory mechanisms and of State ownership of certain key resources (e.g., petroleum); and iii) the demonstration by the Government of Mexico, in the course of the NAFTA negotiations, of its intention to obtain differential treatment for certain strategic sectors.

2. The impact on business strategies

Within this overall framework, the differences in terms of the relative priorities and consistency of the policies used and their results are of significance when it comes to discerning less obvious differences

among sectoral trends and business strategies. In Argentina, the institutional and regulatory crises associated with the import-substitution stage were handled in a way that led to a comparatively greater impairment of the structures and linkages of production activity. Two phenomena attest to this difference, which appears to play a crucial role in determining the nature of the nexus between public policy and private strategies. One is the much more recessionary character—entailing a deeper and longer-lasting slump—of the adjustment carried out during the initial phase of the process. The other is the virtual disappearance of a formal finance and credit system. One major consequence of this was the more widespread use, at a relatively earlier stage, of defensive, cost-cutting corporate strategies.

This difference persists when we compare the steps taken during the structural-reform phase. It was, once again, in Argentina where the most drastic and broadest liberalization, open-trade and deregulation measures were taken and where they were implemented most abruptly in the shortest period of time. This had a twofold impact on firms' corporate strategies. First, it did not give companies time to make a gradual adaption to new competitive conditions, since the measures were implemented in one fell swoop and were in outright contradiction to the lessons gradually learned by those firms from past experiences. Second, it engendered a sense of irreversibility that forced a hasty adoption of long-term decisions. Under such circumstances, there is a tendency either to form partnerships with foreign operators who wish to stay on in the country or to sell off one's holdings and withdraw from the business in question. There are some indications that this path is being taken by many of Argentina's industrial enterprises, including some in the petrochemical industry, and it appears to be the most likely choice for several machine tool enterprises in which family traditions are less of a factor.

It is also evident that, in all three countries, concern to maintain macroeconomic equilibria in the context of mounting constraints on the financing of the external and fiscal deficits was the overriding factor in determining the nature of the design and implementation of industrial policy. Consequently, as greater attention was devoted to their earlier failings and as recommendations for liberalization gained widespread acceptance, sectoral policies were progressively weakened. Here too, however, significant

differences are to be observed. In addition to the increasing difficulty in obtaining financing, the need to establish instruments for promoting and orienting investments and exports of manufactures continued to be a concern in Brazil during both the adjustment and the structural-reform phase.

The greater attention devoted in Brazil to more expansionary macroeconomic policies and to some elements of industrial policy was reflected in short periods of accelerating economic growth in the sector during the adjustment and in the relatively more protectionist nature of trade reforms. It was also manifested in the comparatively greater weight which corporate strategies placed on investment and on expanding production capacity. There appears to be a strong inertial component—what might be likened to a "growth-oriented culture"—in Brazil which influences both public policy and corporate decision-making and which is currently fuelling a heated debate as to the real sustainability of the adjustment and reforms in the absence of a prolonged economic reactivation. Parallel with this, demands for stabilization are less emphatic and concern about the need to define a long-term strategy orientation is more pronounced.

We have tried to make the point that a business firm's own history influences its decision-making process. It also influences the way in which companies interpret the macroeconomic and public-policy signals they perceive. Thus, when companies prepare to adopt long-term strategies, it is crucial that they should have a predictable time horizon in respect of the trends in economic variables and the consolidation of signals regarding long-term production patterns. The beneficial effects of the interaction of consistent public policies, their credibility as an enduring policy base, and the adaptation of business practices to suit the investment requirements generated by those policies appear to be the foundation for the sustainability of any reform programme. The timing and sequencing of policies and strategies is, therefore, of the utmost importance.

Mexico's experiences can serve to illustrate this point. The basic aspects of Mexico's trade reform programme involving the sharpest departures from the preceding scheme were already in effect as of the end of 1988. At the same time, the successes of the anti-inflationary plan were also beginning to take hold, although the probable terms on which long-term debt would be renegotiated with foreign creditors were still uncertain. The first steps were also

being taken to negotiate a free trade agreement with the United States which, if achieved, would have a strong impact on the restructuring of production, whose form and magnitude would also depend on the provisions of such an agreement. In other words, even though the situation had stabilized to an extent that contrasted with the volatility exhibited by relative prices in preceding years and even though the trade liberalization initiative was under way, a high degree of uncertainty remained with regard to the financial and production environment over the long term.

Business firms' initial response to this state of affairs was to place priority on defensive and cost-cutting measures while shelving initiatives relating to technology and investment and focusing their strategies on commercial operations and on the replenishment of financial stocks and corporate assets. It was not until 1992 –after more than three years of fairly stable domestic price levels, after two years of

participation in a Brady Plan arrangement, and after the NAFTA negotiations had advanced quite a long way– that the investment process seemed to revive. None the less, more active strategies in the area of technology are still lacking.

A number of lessons can be drawn from an examination of the situation in Mexico. First, it is necessary to take into account the time period that will elapse between the implementation of reforms and the redefinition of private strategies and, in particular, the importance of making the economic agents feel certain about the long-term outlook, as a guide for business decisions. Second, if companies delay the resumption of their investments this may destabilize the country's fiscal and external positions, thereby prompting further uncertainty. How to go about balancing the two would appear to be the chief economic policy issue at the present time for the open economies of Argentina, Brazil and Mexico.

V

Conclusions

Protective policies and State assistance encouraged the establishment and development of a strong industrial production base in Argentina, Brazil and Mexico. However, excessive levels of protection and the redundancy of some promotional incentives enabled industrial firms to operate with high costs and to obtain windfall profits. These firms' market power and the increasing consolidation of patterns of high inflation made it possible for them to pass on these high costs in their prices and inhibited a better distribution of the benefits derived from the maturity of projects to final or intermediate consumers.

The above features characterized the development of the petrochemical and machine tool industries in all three countries, especially during the 1980s. They were more marked in the petrochemical industry, due to a combination of promotion programmes designed specifically for that sector and the presence of oligopolistic markets and large enterprises. In the machine tools industry, on the other hand, these characteristics were somewhat less evident because the promotional instruments used in this sector were weaker, its protection was undermined by tariff rebates for imports of

equipment, and the small and medium-sized machine tool firms that make up the majority of the sector had less market power.

These companies' maturation, in terms of technology and production, was associated with the expansion of their production capacity and the prospect of a broader demand base. The petrochemical companies covered by the study invested in international-scale plants equipped with what were state-of-the-art technologies at the time (1970s and 1980s), thanks to strong government incentives. Brazilian and Argentine machine-tool firms that were prompted to move into the production of CNC machine tools during the 1980s by the emergence of a new technological pattern based their leadership strategies on what appeared to be a predictable scenario of expanding national or regional markets.

In the petrochemical industry, once the firms had ruled out the possibility of reaching the research and development expenditure threshold necessary to attain major process and product innovations, they successfully set about optimizing production processes and ensuring proper management of their plants so as

to maximize the rates of return on their operations, and in Brazil and Mexico, some companies planned to produce more complex specialty products. In the machine tools industry, there was greater leeway for decision-making regarding technical and production matters, and some firms moved into the production of CNC machine tools (usually with the support of foreign partners or licensors), although they lagged somewhat behind the main firms and producer countries. Others, however, whether for reasons of size, because they were risk-averse or because they specialized in less dynamic products, chose not to strike out in a new direction.

A closed economy proved to be no obstacle to some firms' decision—in the context of specific prospects for expansion or reserved markets—to undertake technological activities and efforts within the bounds defined by the structural conditions and pattern of internationalization in each sector. Their increased productivity was not, however, passed on in the form of lower prices. The lack of incentives or pressures to induce firms—once their projects and their manufacturing capacity had reached a mature stage—to transfer more of those benefits to users was a major failing of the industrial policy pursued in the 1970s and 1980s.

The combination—to varying degrees in each country—of an adverse international situation, macroeconomic difficulties and structural reforms interrupted the growth of these firms. Under these new circumstances, the response of most companies was to streamline operations and cut costs in order to eliminate the accumulated “fat” that could no longer be easily incorporated into prices and to position themselves in mature product lines while de-prioritizing or abandoning projects to expand their capacity and upgrade their technology. The greater exposure to competition that accompanied the new macroeconomic and public-policy setup has led to a relative reduction in domestic prices; however, far from prompting more aggressive action in the areas of production or technology, it appears to have done just the opposite.

When they found themselves in an open economy, the petrochemical companies which had intended to move into the production of more complex products abandoned those plans, while machine-tool producers that had forged ahead with the new CNC paradigm began to encounter difficulties in sustaining their production levels. With the exception of the

machine-tools sector in Mexico, the cases analysed in this study all refer to well-established industries with a long history in the sector which have already developed entrepreneurial, manufacturing and technological capabilities. The initial responses of such firms would not normally be expected to include the abandonment of their line of business or their conversion into importers.

When the growth path of these enterprises was affected by these changes, they took refuge in mature products and market niches protected by location-related advantages. The prospect of greater competition brought about by reform programmes neither awakened nor engendered a bold or enterprising spirit in producers, but it did not immediately push them out of the sector either. These firms are betting that they can survive by downscaling their business structures and, in some cases, taking in foreign partners. It might be argued that not enough time has passed to prove either the “increased-efficiency” or the “de-industrialization” hypothesis. Some reflections on this point are warranted.

First of all, the decisions taken by companies when responding to a new set of conditions are influenced by their past history; in a situation where they are uncertain as to future trends in national and international markets and are without the potential benefits of a promotion-oriented regulatory framework, business enterprises will prefer to take defensive action. In turn, their responses in the short run will influence their possible choices with regard to future action. Thus, the passage of time is not a neutral factor, as the “increased-efficiency” argument would seem to suggest.

In the petrochemical industry, sharp reductions in staff assigned to non-routine tasks not only caused local firms to set their technological sights lower than before, but also weakened their bargaining position with international suppliers. Under these circumstances, the cost-cutting steps being taken will clearly influence future decisions regarding any possible expansion of a firm's physical or technological capacity. To keep market opportunities open, however, some enterprises will have to become vertically integrated—a process that will be facilitated by the moves towards privatization and deregulation now being made. This will help such firms to attain a more competitive scale of operations and will place them in a position to arrive at private agreements that will help to put the market in order and reduce the scope of externalities associated with increased competition.

In the machine tools sector, the cancellation of investment plans and sudden lay-offs of skilled personnel—the most highly valued asset in this industry—may seriously jeopardize attempts to maintain existing operations or, some day, to expand them in the most technologically sophisticated segments. The acquisition of a leading firm in Argentina by a large Italian enterprise and the increasing difficulty in gaining access to this type of technology without the help of foreign partners are indications of more limited degrees of freedom for progress by local firms outside of those market segments in which location-related advantages carry a great deal of weight.

These trends stand out more clearly in Mexico, where more time has passed since the introduction of reforms. The above discussion regarding structural factors that influence corporate decisions suggests that the strategies currently being used by Mexican firms may be adopted later on by Argentine and Brazilian industries. Changes in the macroeconomic and public-policy environment could, of course, generate different scenarios. If this were to occur, and considering Brazil's history of industrial development and the particular features of its State and entrepreneurial class, a more dynamic and complex set of conditions might well emerge in that country.

(Original: Spanish)

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