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The ongoing history *of a Chilean metal products and machinery firm*

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Processes of adjustment and restructuring of the production sectors to a new system of macroeconomic incentives are slow, costly and more inefficient than conventional microeconomic theory would lead one to suppose. In this article, the authors explore the process of the restructuring of production of a Chilean metal products and machinery company and the way it gradually modified its operations from the 1970s onwards, adapting them to new macroeconomic and mesoeconomic signals. As is well known, in the last two decades the system of incentives and the regulatory framework for production activities in Chile have undergone profound changes, gradually moving –with advances but also setbacks– towards an organizational model more open to external competition, more deregulated, and with less public sector participation in the field of production proper. In the case of the company studied here, in spite of the considerable length of time that the Chilean economy has been open to the exterior and the fact that the company has been notably successful in its global restructuring, the transition to international levels of productivity is still not complete and displays areas of fragmentation and weakness. Section I of the article describes the general background for the functioning of the Chilean economy in which the company's activities evolved; section II describes the evolution of the firm's manufacturing facilities, and the third and last section explores the links between microeconomic and macroeconomic aspects and sets forth some conclusions drawn from this study.

I

Introduction

Economists tend to prefer to make a macroeconomic interpretation of a given situation and hence to pay less attention to what happens to individual economic agents. This is partly because the conventional theory of prices is constructed on the basis of the stylized behaviour of a given "representative agent" who maximizes his profits in conditions of perfect information. In an analytical framework of this type, it may be assumed that in the long run the branches or sectors of production adapt to a new set of macroeconomic signals and that the adaptation path followed by a particular firm is irrelevant.

Observation of actual situations, however, shows us that the processes of adjustment and restructuring of a given sector of production to a new system of incentives are slow, costly, and more imperfect than conventional microeconomic theory would lead us to suppose. In the real market, there are entries and exits of firms, gradual processes of factory reorganization, and changes in the levels of vertical integration of the plants, the ownership of enterprises and the level of sectoral economic concentration, in the course of a complex and highly idiosyncratic episode of structural mutation. The interdependence between the macro, meso and micro dimensions is still essentially unknown, although, intuitively, we perceive that the adjustment process may well end up by irreversibly conditioning the structure and long-term behaviour of the branch of production or economy in question.

In the last two decades, the system of incentives and regulatory framework in which production activity takes place in Chile has undergone profound changes. It has gradually been moving towards a

form of organization of production which is more open to external competition, more deregulated, and with less public sector participation in the area of production proper.

The individual economic agents have slowly been adapting to these changes. We know little, however, of the way these complex processes of structural mutation have been metabolized at the microeconomic or sectoral level.

From this standpoint, we have considered it of interest to explore the production restructuring process of a Chilean metal products and machinery firm—the Compañía Tecno Industrial (CTI)—and to see how it gradually modified its operations over the last three decades in order to adapt to the new macroeconomic and mesoeconomic signals. It also seemed interesting to us to try to determine how far the evolution of the CTI reflects what has happened in the Chilean metal products and machinery industry as a whole.

We will show that in spite of the already longstanding external openness of the Chilean economy and the successful global restructuring of the firm in question, the transition to international levels of technology is still incomplete and shows areas of fragmentation and weakness. Only recently—with the initiation of talks on the possible entry of Chile into MERCOSUR—did the CTI begin to perceive that it would henceforth have to face stronger competition from big world producers and that it would have to take much more account of the organization of production and the rate of technological change displayed by this branch of industry in the developed world, if it is to preserve its independence in the long term.

□ This study was carried out with the collaboration of various executives of the Compañía Tecno Industrial (CTI) and has been published after express consultations with that firm, whose co-

operation and permission for publication are gratefully acknowledged. The views expressed in this article are of course the exclusive responsibility of the authors.

II

The global Chilean context, 1970-1994

The Chilean manufacturing sector has passed through various periods of crisis and recovery in the course of the last three decades (figure 1 and table 1). It was only towards 1992 that the industrial product recovered the level that it would theoretically have reached on the basis of a simple extrapolation of what happened in the 1970s. During this period of time, there was under-utilization and destruction of installed capacity which meant the closure of factories, unemployment and waste of the technical capacity accumulated by society. In the last few years covered by the figure, however –1991 to 1993– industry increased its rate of expansion.

Within this lengthy period, we shall highlight three clearly differentiated stages: 1974-1981, 1982-1986, and the stage of recovery and faster expansion in 1987-1994.

1. The 1974-1981 stage

After the military coup of 1973 there began "... one of the most dramatic economic reforms ever recorded in the history of Chile" (Corbo and Sánchez, 1992). The aim of the changes was to propel the country towards a social organization model which was more deregulated, open to external competition, and basically guided by the market signals. This transition

took place in an atmosphere of economic recession and harsh social repression.

Various Chilean economists have sought to explore the economic consequences of this epoch-making change. Thus, Mizala (1992) shows that it was not only the opening-up of the economy to the exterior which affected the manufacturing sector, but also the drop in domestic demand, which was a decisive factor in reducing the level of industrial activity in the country in those years. Thus, in a context in which it was difficult to expand exports as a counter-cyclical measure, the drop in domestic demand is seen to be the main factor in the decline in Chilean manufacturing production. It was only later, between 1979 and 1981, that imports gave local firms a further reason for concern. This means that the replacement of locally produced goods by imported products did not take place immediately after the reduction of tariffs, as macroeconomic adjustment models sometimes suppose; instead, it took some time for imports to begin to act as an element disciplining local producers. In 1982, a recession and a drop in domestic demand adversely affected the sector once again.

V. Corbo classifies the structural reform policies of this period in five main groups: i) those aimed at eliminating price controls in merchandise markets, ii) those designed to liberalize the financial market,

FIGURE 1
Chile: Evolution of industrial output, 1957-1993

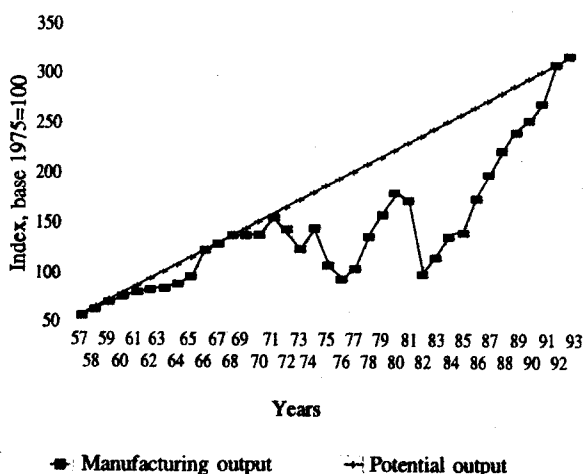


TABLE 1
Chile: Average growth of industrial output
in selected periods between 1958 and 1993
(Percentages)

Period	Growth rate
1958-1993	4.27
1958-1973	4.40
1974-1992 Market phase	4.50
1973-1976 Crisis 1	-11.52
1977-1981 Recovery from crisis 1	7.34
1982 Crisis 2	-33.74
1983-1992 Recovery from crisis 2	11.31
1989-1993 Recovery stage	11.77
1992-1993	17.32

Source: INE, various years.

iii) those intended to make labour markets more flexible, iv) those aimed at controlling and reducing the fiscal deficit, and v) those designed to reduce the State's participation as a producer of goods and services (Corbo and Sánchez, 1992).

The macroeconomic stabilization and structural reform efforts mentioned above affected the performance of the Chilean manufacturing sector in various ways:

i) industry as a whole lost approximately 20% of its share in GDP, which went down from 25.4% in 1970 to 21.5% in 1980 and 20% in 1982.

ii) the effective rate of protection fell sharply, reaching an average of 14% in 1979.¹

iii) the general functioning of the labour market underwent a radical change with the prohibition of all forms of trade union activity.

iv) the number of industrial enterprises went down by 13% between 1967 and 1979 (Mizala, 1992), especially in the case of small and medium-sized family companies; there was a big increase in external competition, and industrial employment fell dramatically.

v) the industries most seriously affected by competition from imported products were those in divisions 32, 36 and 38 of the International Standard Industrial Classification (ISIC), corresponding to textiles, manufacture of non-metallic mineral products, except products of petroleum and coal, and manufacture of fabricated metal products, machinery and equipment. Moreover, "In terms of profitability, the enterprises competing with imports turned in the worst performance, which was only to be expected in view of the adverse conditions that those companies had to face during the entire period" (Mizala, 1992). The enterprises in the natural resources sector stood out from the rest, however, because they benefited from the greater trade openness.

In order to adapt to the new economic context,² enterprises adopted the following measures:

i) rationalizing their style of management and organization of work, reducing the variety of products manufactured and increasing the content of im-

ported inputs per unit of production, thus improving labour productivity and profits without having to make big investments in new equipment.³

ii) improving product quality by reducing the number of products manufactured locally and increasing the range offered on the market through the importation of those which were not produced. For the companies exporting industrial commodities, the change in production strategies was minimal.

iii) changing the composition of their assets by changing their physical assets into financial assets and preferring speculation rather than real investment in machinery and equipment. The level of indebtedness was increased, first in pesos and later in dollars, and stocks were reduced to a minimum. A. Mizala argues that it was the financial problem which most affected companies and that many of those which went bankrupt did so because they were not able to adapt on the financial side (ECLAC/CIID, 1995).

In short, the increased trade openness and macroeconomic stabilization policies caused companies to make an effort to rationalize their organization of work. The firms which survived tended to become assemblers of imported parts and components and to supplement their line of products with completely knocked down (CKD) products imported from abroad. The branches processing natural resources tended to gain ground in relative terms within the overall industrial structure, at the expense of the branches engaged in production for the domestic market.

2. The 1982-1986 stage

In Chile, as in the rest of Latin America, these were years of serious external imbalances caused by the increase in international interest rates, the drop in the terms of trade, and the absence of international financing after the Mexican moratorium of 1982. These factors gave rise to rapid expansion of the external debt and forced the various governments to seek financing domestically, with the consequent impact on inflation.

In these years, the Chilean economy was open to external competition and was very sensitive to disturbances coming from the exterior. The measures adopted by the economic authorities in order to face

¹ The relatively small increase in the CTI's exports was due to the initially low competitiveness of this firm compared with advanced international practices.

² It should be noted that we are referring to the sectoral average. Obviously, there are particular types of activities which behaved differently (see Agacino, Rivas and Román, 1992).

³ Although there was only evidence of increases in efficiency between 1974 and 1979, since afterwards there was a decline up to 1986 (Marshall, 1992).

the problems of this period consisted basically of partly closing the economy and applying countercyclical expansionary policies. They sought to "manage the exchange rate as the main instrument for tackling the external imbalance, supplemented by increases in tariffs" (Meller, 1992). In addition, certain prices (those of agricultural products, for example) and interest rates were controlled once again, as was the growth of public expenditure.

The GDP went down by 14% in 1982 and 0.7% in 1983. In that same year, the unemployment rate rose to 28.5% and imports fell to less than half of their 1981 level. The recovery of the external sector of the economy was begun. In the manufacturing sector, the product went down by 21% in 1982 and employment fell by 27%. A period of severe disinvestment began which reached its peak in 1984 when investment was 45% below the 1979 level. The sector of small and medium-sized enterprises was the most sensitive to the changes, thus further increasing its lag with respect to the big firms. The change in exchange rate policy improved the profitability of the sector engaged in the processing and export of natural resources.

The protectionist measures taken improved the profitability of the branches of production devoted to the domestic market, although there was a general climate of uncertainty and discouragement with regard to investments in those sectors. The industrial commodities sector turned in a particularly buoyant performance, but loss of dynamism prevailed in the rest of the branches of production.

In short, this period was marked by a high degree of macroeconomic imbalance and turbulence. There were numerous bankruptcies of companies. The industries processing raw materials gained ground in relative terms, and there was an increase in the degree of economic concentration within the manufacturing sector, because of the relative failure of the small and medium-sized enterprises to adapt to the new conditions of the macroeconomic environment.

3. From 1987 to the present

In this period, the trade openness process was resumed with a reduction in tariffs, and the economy recovered and began to grow again. This took place against a background of change in the political regime. The need to take care of social objectives was raised once again, but subject to the need to respect the restrictions imposed by the macroeconomic bal-

ances. Taking this into account, it was decided to increase taxes in order to avoid financing social expenditure through money issue or public indebtedness. The idea that the market is a better means of allocating resources than the State authorities was still not questioned, but deregulation was not complete or universal, since it was not applied to financial activities, copper mining, etc. The Frei Ruiz-Tagle administration maintained essentially the same concept of social organization as its predecessor in power.

According to some authors, a quarter of the expansion achieved in this stage was due to the growth in domestic demand and almost two-thirds to export openness (Agacino, Rivas and Román, 1992). In these years, enterprises finally put their financial situation on a sound basis.

The global economic situation showed clear signs of improvement. Inflation continued to go down, the growth rate rose, investment increased, there was a growing inflow of external capital, the domestic saving rate increased, and real wages and exports rose. At the same time, a clear appreciation in the real exchange rate began to be observed.

In the manufacturing sector, there was an improvement in the level of employment. Investment increased, but in 1988 it had still only recovered the 1979 level, and in 1989 the 1981 level.

From 1988 on, manufacturing exports became more diversified and continued to expand, thus indicating that the sector's orientation towards the external market was increasing in spite of the appreciation in the real exchange rate.

Business strategies (Castillo, Maggi and Dini, 1994) concentrated on the following aspects:

i) *Management*. The professional level of management staff rose and there was an increase in the tendency to work in teams. The dominant trends were aimed at making the command structure smaller and more flexible and incorporating new functions associated with information technology.

ii) *Growth*. Here, there were at least three different strategies: expansion of existing plants, establishment of new plants, and the acquisition or takeover of existing companies. In most cases this has been done with the company's own funds, even though most firms consider that there are no obstacles to access to the financial market.

iii) *Human resources*. The trade unions continue to take very little part in modernization decisions. Companies are beginning to make use of fiscal incentives for training.

iv) *Technology*. Efforts to improve product designs are being accentuated in an effort to reach differentiated consumers and particular market niches. Changes in production are based on the purchase of machinery and the adaptation of technology acquired abroad to the scale of the Chilean market. There is not much concern for reducing lost time by carrying out time and motion studies.

v) *Marketing*. Efforts are being made to differentiate products and to gain better market positions through brand names, quality, and the development of customer service facilities and preferential distribution networks. Trade alliances are also being established and areas of business are being diversified. The degree of subcontracting is only low.

In short, since 1985 industry has grown through the incorporation of factors of production, especially labour, in contrast with what happened in the previous stage, where there was an effort to save labour in absolute terms. For this reason, labour productivity has not significantly increased. The last three years, however, seem to be witnessing a trend towards greater dynamism than in previous periods, which is reflected in the faster incorporation of numerical control equipment, CAD and CAD-CAM systems, automatic process control technology, some use of robots, etc. Although very recent, these developments would

appear to suggest some speeding up of manufacturing growth in Chile.

There are some aspects which are worthy of emphasis. There are indications that industrial exports are becoming more diversified and expanding to an extent commensurate with the recovery in industrial investment in recent years, and that subcontracting is also becoming more prevalent. Looking at the different branches of industry, it may be noted that it is the export sector which has developed most dynamism and attained the greatest relative weight in manufacturing production, but the sustained growth of the economy has also meant that industries producing for the domestic market have also improved their rate of expansion. Employment, however, has shown some tendency towards relative stagnation.

This shows that the process of recovery of industry in the 1980s was based on the reallocation of resources from branches serving the domestic market to others which make more intensive use of capital and produce industrial commodities for export. With regard to the morphology of the markets, two important facts may be noted: in the consumer goods segment, there has been an increase in competition at the local level, while in the industrial commodities markets the supply has come from a small core of big corporate groups strongly oriented towards exports.

III

The evolution of a metal products and machinery firm: the case of CTI

This section describes the evolution of a firm producing household appliances (refrigerators), in which three different stages may be distinguished in recent decades (figure 2).

The firm is currently an open limited company producing cookers, refrigerators, washing machines and heaters under the brand names Fensa, Mademsa and Ferrilloza. It also markets a wide range of domestic electrical appliances which it does not produce itself.

The firm has relations with over 50 suppliers (many of which are located abroad: Belgium, Brazil, Italy and Japan). It employs some 1400 workers and operates basically as an assembly firm in which 70%

of the manufacturing cost corresponds to imports of parts and components.

After this brief background information, let us now look at the way this firm has evolved.

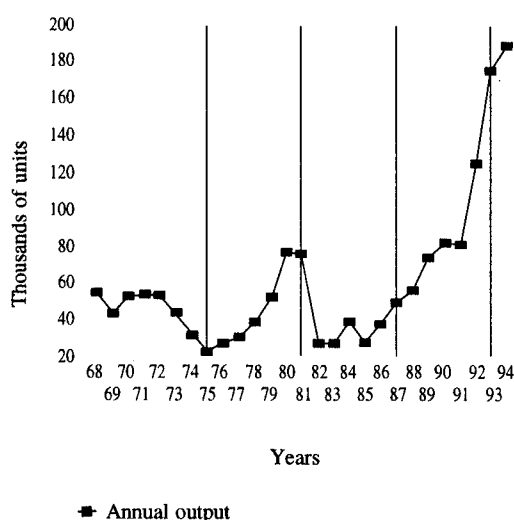
1. Expansion and production reorganization stage (1975-1981)

a) *Organization of production and process engineering*

After the firm was returned to private ownership, a restructuring process was begun with the aim of achieving economies of scale and specialization by progressing from batch production to continuous-flow production.

FIGURE 2

**Compañía Tecno Industrial (CTI):
Refrigerator outputs, 1968-1994**



The merger between Fensa and Mademsa, which took place in 1975, gave rise to the present CTI—Compañía Tecno Industrial S.A.—and all production was concentrated at the Fensa plant located at Maipú.⁴ The merger was carried out in order to face the trade openness process, which involved a probable increase in foreign competition. Before the merger, Mademsa was made up of four plants in three different locations, which employed some 2,000 persons at the beginning of 1975.

Fensa, in contrast, had only a single factory, at Maipú, which was organized in a more rational and orderly manner and employed approximately 1900 persons.

The merger led to staff reductions: 1500 workers took voluntary retirement in a climate of great worker/employer tension. Relations between the company and the trade unions passed through a very conflictive stage.

Perhaps the most interesting feature from the technical point of view was the rapid replacement of the batch production model with one based on continuous-flow methods. In Mademsa, the general manager negotiated with each worker an informal contract laying down the output expected from the latter and the agreed remuneration. This meant that

there was a multiplicity of contracts within the plant and each worker had a good deal of freedom to design his own production process, developing his own equipment and tools to carry out his job. Each of the workers was a metalworking craftsman skilled in a wide range of metalworking sub processes, such as stamping, soldering, turning, etc. There was no time and motion department, since it was the worker himself who was responsible for improving his production times and thus earning the benefits of his greater productivity.

In Fensa, the production organization model was very different and much more conventional. The production line system was used, and workers received bonuses for outputs higher than the basic levels expected. The workers did not have freedom to organize their own work, and they did not have to construct their own tools and dies; they were not responsible for the finished product, but only for a specific task in its production. They were subject to a rigid system of time and motion studies, and the planning of production was much more detailed and highly controlled, on the basis of Taylorist methods of organization.

Thus, the Fensa/Mademsa merger involved a confrontation between two different organizational models and two different business “cultures”. One of them had to dominate over the other, and in this case it was the Fensa model which won. Absorbing the differences naturally took time, and it was only towards 1979 that there was complete fusion of the system under the Fensa model. It was necessary to forbid the former Mademsa workers to make their own tools and dies, which meant the loss of the craftsmen’s training they had brought with them from their previous working experience.

Progress was made in the reorganization of production processes during the period 1973-1976. Even so, according to one report the factory organization was still not very rational in 1977, since the work stations were not clearly delimited, the tools were not standardized, there were assembly lines parallel to the central production line, a lot of time was spent on materials handling, and there were many points in the line which held up the production flow.

Efforts were also made to improve the organization of work in the administrative area, with the introduction of computers in 1977. This change took many months and led to the dismissal of nearly 60 administrative employees.

⁴ Mademsa was absorbed by Fensa, probably because of its lower yields due to the fact that it produced its goods in small batches instead of in a continuous flow.

Like many other Chilean firms, CTI was faced with a big increase in domestic demand in 1979-1980. At that time, the firm reached the limits of its installed capacity and decided to deverticalize production and devote itself solely to the final assembly of refrigerators. As a result, the management had to organize a complex system for the purchase of parts and sub-assemblies on the international market, embarking on a new model of organization of work based on the assembly of imported components.

In 1980 and 1981, more efficient thermoforming equipment was purchased, resulting in a reduction of nearly 20 persons in the labour force. The company stopped producing evaporators, which it began to import from Japan, and also filters and condensers, which it began to bring in from Italy. The compressor plant was sold to Brazil and the production of electric heaters was transferred to Fabritel, grills to Lioy and Ferromat, motors to Somela, and so forth.

With this process of deverticalization, the firm concentrated on a smaller number of activities, retaining only the most profitable ones.

Up to the early 1980s, the engineers and technicians of the company did not specialize in particular lines of products. Each engineer worked on several different lines, thus losing economies of specialization. At the end of 1980, a more specialized form of organization was established, clearly oriented towards specific products, through the creation of four engineering departments: refrigerators, heaters, cookers and washing machines.

This restructuring made it possible to reduce the number of workers from 2500 in 1975 to 1300 in 1980.

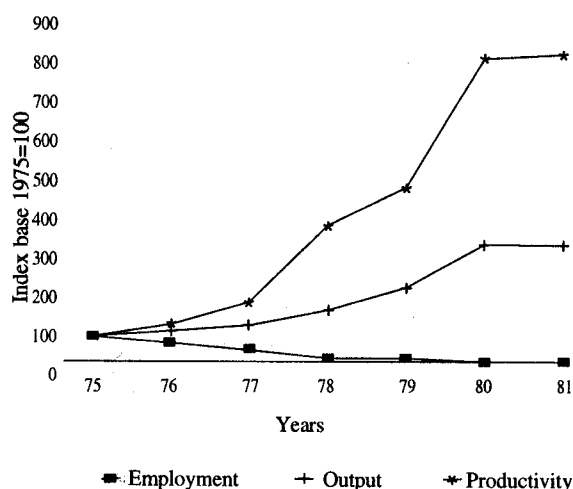
b) *Product design*

The company did little in the area of product design until well into the 1980s. In 1981 it still did not manufacture two-door refrigerators, so it tried to develop a product of this type for itself by copying an already elderly German model. From the original design concept up to the entry into production, this project took two years, so that the refrigerator first came into production in June 1982. The range of models manufactured was reduced from 9 to 4, the remainder of the lines marketed being imported.

In short, it can be said that in this first stage of its history of adaptation to the macroeconomic changes, the company sought economies of specialization by reducing the range of products manufac-

FIGURE 3

Compañía Tecno Industrial (CTI):
Evolution of selected indicators, 1975-1981



tured, transferring all production to a single plant, organizing its installations into production lines, reducing the degree of vertical integration and in-house manufacture of parts and sub-assemblies, increasing the imported content, making more use of subcontractors, reorganizing work processes, and introducing computation into the administrative area. In addition, it reduced the number of workers employed by almost 50%, unified the system of remuneration, and eliminated the system of organization in work groups.

These changes had satisfactory results, as is shown by the corresponding indicators (figure 3). Production was doubled, and labour productivity increased. The company used its idle capacity and made organizational improvements, but did not make any big investments in capital goods. Its profitability improved, and since 1979 it has shown a profit.

2. The 1982-1986 crisis

a) *Organization of work and process engineering*

The 1980-1981 period marked the end of an expansionary cycle. In 1982 the Chilean macro economy entered a phase of heavy turbulence. There was a big drop in the physical output of the firm, and this, together with bad business transactions with foreign firms and a high level of indebtedness, placed the company on the brink of bankruptcy in early 1983, when it passed into the hands of its creditor banks.

The following measures were taken in order to face up to this crisis: i) a new wave of mass dismiss-

als was begun, extending all the way from managers to factory hands; ii) the company began to produce goods to order for third parties, simply in order to keep the plant going, which led to a return to production in small batches, and iii) there was a return to the vertical integration of processes making intensive use of labour, in order to keep the staff occupied.

In 1985, the firm only had 300 employees.

At the end of that year, the company began to recover once again. Within a much smaller global market, its relative share marginally improved at the expense of its local competitor (Cimet/Sindelen) and of the many importers who massively withdrew from the local market.

b) *Product design*

In an effort to overcome the crisis, various modifications were made in product design. Thus, the number of models manufactured, which only amounted to 4 in 1980, rose to 13 in 1986. There were changes in design, refrigerator parts and components were replaced with others made of aluminium, designed and manufactured within the company, and a manually operated machine was constructed within the company for the in-house manufacture of aluminium cooling spirals, which had previously been imported.

In short, in this second stage the increase in interest rates and the devaluation of the peso resulted in a big drop in the physical output of the firm and led to a financial crisis. The company changed its owners, its production strategy and its markets.

It dismissed a large proportion of its labour force. It sought to diversify its production and began to work to order for third persons once again, in small batches. It resumed labour-intensive activities in order to take advantage of its installed capacity, which was heavily underutilized, and it made only marginal attempts to export its products as a countercyclical measure. The range of products manufactured rose from 4 to 18. In the final analysis, output and employment fell, the productivity of labour rose because of the big reduction in the number of workers, and the firm went through a stage of heavy turbulence and instability.

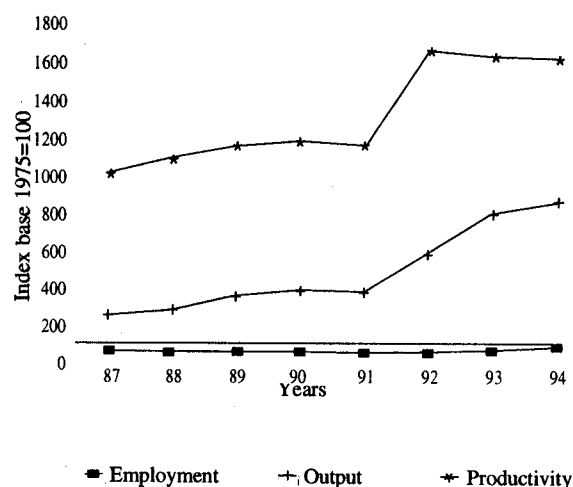
3. Expansion from 1987 on

a) *Organization of production and process engineering*

In 1987 CTI changed ownership once again. A little later it was decided to build a new refrigerator plant to produce 200,000 units per year. It was

FIGURE 4

Compañía Tecno Industrial (CTI):
Evolution of selected indicators, 1987-1994



estimated that this would be the domestic demand towards the end of the century.

In 1989, preparations began to be made for the implementation of the expansion programme. The management structure of the company was changed and the departments of production, engineering and development were set up. In 1990, the new owners invested nearly US\$ 5 million in the construction of a new factory. Modern automated equipment was installed for phosphate coating and painting in order to overcome the main bottleneck on the production line. The volume of employment and output was doubled. The new plant, with a floor area of approximately 9,000 square metres, came into operation in April 1991.

The growth of demand greatly exceeded what had been expected, and the firm had to face unexpected organizational problems, which explains its somewhat disorderly growth during the last few years. Few of the sub-processes are automated as yet.

Since 1993, the company has tried to improve the average level of training of its staff through talks, workshops, etc.

b) *Product design*

In the second half of the 1980s, the firm made little progress with regard to product engineering. It continued to produce a hybrid two-door refrigerator, using the basic design and even the dies of "old" models. The number of models continue to increase, reaching the figure of 18 in 1989, but thereafter it began to go down and stood at 14 in 1991. In the latter year the firm began to use the CAD system in

the design of new products, but design times continue to be substantially longer than those achieved by leading international manufacturers.

By 1994, the new plant was working at full capacity with two shifts and even three in the case of certain sub-processes. Some of the sub-processes use advanced technology, but others use old-fashioned and sometimes almost artisanal techniques. The plastic sheets are cut with two machines: one of them a modern computer-aided machine with a very precise heating system, operating at high efficiency and speed, and the other an "old" machine with lower output, with 10 times more variation in the heating phase and lower cutting efficiency.

The plant may be viewed, then, as a set of islands of great modernity in a global sea in which there are still pieces of equipment, dies, organizational concepts and other elements which are typical of a factory of two or three decades ago.

In spite of the fact that the new factory has only recently been put into operation, questions are arising once again about the best growth strategy for the future. A recent visit to factories producing refrigerators in Southeast Asia showed that the international technological frontier with regard to process engineering now involves the elimination of painting operations and their replacement by the use of pre-painted steel sheets delivered to the factory ready for the assembly of the refrigerator. The painting section has once again become a bottleneck because of the rapid expansion of the volume of production, so that the dilemma has once again arisen as to whether

to deal with future expansion by increasing the size of the painting section or replacing it with technology based on the acquisition of pre-painted metal sheets. It was finally decided to import pre-painted steel sheets, which will make it necessary to acquire machines to work with this type of sheet.

The South Korean firm Samsung manages to produce nearly 120 refrigerators per hour, i.e., twice as many as the Chilean firm, in a smaller physical space. Its production is organized on the just-in-time system, with almost no lost time. The Chilean plant, in contrast, still has to ensure constant supply of the production line through an efficient system of material stocks. For this purpose, the imported materials are stored almost a month in advance.

If we compare the local firm with its external competitors, we see the following:

i) it still needs nearly two years to bring a new product design onto the market, and it has achieved relatively little improvement in this respect over time. It still works on the basis of the construction of prototypes and their subsequent experimental testing, although it already has a two-dimensional AUTOCAD system. In contrast, Japanese producers, for example, take less than a year to design a new product, work in three dimensions, and can design their products by simulation.

ii) the information obtained suggests that the Chilean firm is lagging well behind the Japanese plants. The lag is smaller with respect to the Korean factories, but they themselves are somewhat behind the best world technology.

IV

Microeconomic behaviour and the changes in the Chilean macro economy

In the preceding sections of this article we looked first at the historical evolution of the Chilean manufacturing sector and then at the successive restructuring processes of a refrigerator manufacturing plant which has had to adapt itself to the changes in the regulatory framework and system of incentives prevailing in the country. In this effort to adapt, the firm has acted in ways which in many respects reflect the more general behaviour observable in many other

Chilean firms. In this sense, the study of different cases acquires a broader descriptive value which goes beyond the individual cases in question. In this section we will try to link the case of the individual firm with the variables of the broader universe of firms in order to study the complex micro/macro links underlying the structural adjustment process of the Chilean economy. We will begin by using conventional price theory instruments and then proceed

to a somewhat broader interpretive framework which will allow us to incorporate recent Schumpeterian-based ideas on the theory of evolution.

1. Some central features of the case studied, viewed from the standpoint of conventional microeconomic theory

From the standpoint of conventional microeconomic theory, the present case study displays the following features:

i) translation and rotation of the demand curve as a function of the price and income effects deriving from changes in consumer preferences, in income distribution, in the degree of external competition faced by the company, etc.;

ii) translation and rotation of the cost curve in response to the drop in real wages, the fall in capital costs and the impact of disincorporated technological change and economies of scale.

For the effects of the analysis, it is important to remember that the firm changed its owners and strategies several times and that when each group of owners took over its management they brought with them their own view of the general situation of the Chilean economy and the role to be assigned to this firm within their economic group as a whole.

In one case, the firm was used as a means of procuring funds to be used mostly in other business activities. In another, the creditor banks which took over the firm after its commercial failure in 1982 sought to recover the capital invested in it. Finally, the group that took control of CTI in 1987 had objectives which were closer to the conventional idea of technical modernization and gradual improvement in technical efficiency normally expected from a firm in conditions of macroeconomic stability and proper functioning of the factor markets. In other words, it is only since 1987 that we can speak of a long-term strategy proper.

2. The macroeconomic situation and the behaviour of the firm from the standpoint of conventional economic theory

Using the conventional instruments of price theory, we can represent what happened in this case in the following manner (figure 5). The CTI acts as a large monopolistic firm, fixing prices within the range of increasing marginal costs, while its smaller competi-

tors (CH) operate as non-differentiated firms with constant marginal costs. The importers (OM) have constant costs. If the external tariff is very high, they simply remain outside the market. The initial situation before openness is seen as follows: the firm "sets" the market price at p_{cti} and produces Q_{cti} . The small firms produce Q_{ch} , taking the price set by the CTI. The total amount produced is Q_t .

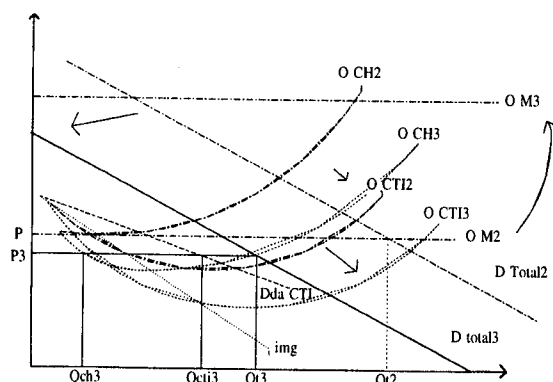
In 1975, when the firm was returned to private ownership, it sought to reorganize its operations after the conflictive period in which it was in the "area of social ownership", merging with another firm to obtain economies of scale and specialization; it rationalized its processes and the range of products manufactured and made some changes in production technology; it gave preference to speculative forms of behaviour, became indebted, and did not opt for long-term technological development; and it expanded its physical volume of production and improved its labour productivity, reducing the number of workers.

During the period 1975-1982, the firm suffered the impact of various disturbances coming from the macroeconomic environment: i) the global recession which affected the Chilean economy through the macroeconomic stabilization programme; ii) the trade openness process, with appreciation of the real exchange rate; iii) the increase in imports of replacement goods; iv) greater domestic demand from the high-income strata and the consequent change in consumer preferences, and v) the rise in interest rates. The effects of these disturbances were reflected, as we noted earlier, in the translation and rotation of the demand curve, variation of the cost curve, a drop in the real level of external protection, etc. (figure 6).

The importers' costs went down (from OM to OM2). The demand function was transferred to the exterior and rotated about its axis, becoming more elastic and reflecting the process of concentration of income. Thus, it went from D total to D total2. The demand facing each competitor was more elastic, since the variety of supply increased with the entry of the importers, who set the market price at P . The domestic firms rationalized their production, seeking to drive down their marginal cost curve. Several domestic competitors were eliminated from the market: i.e., the situation went from OCTI to OCTI2, but it was not possible to manufacture refrigerators at lower costs than those of the imports. The share of CTI went down to 30% of the market, while the importers came to cover 60% of the market. As the price of

FIGURE 7

Compañía Tecno Industrial (CTI):
Effects of the 1982 crisis



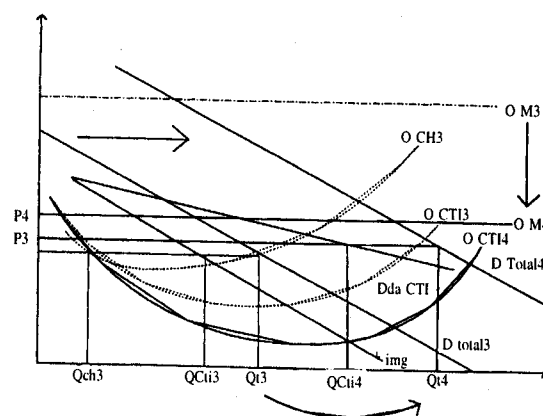
Since the late 1970s, the CTI has learned to buy and sell, differentiating markets, in crisis periods. It has also become more flexible in the organization and management of its labour force, so that it has managed to attain competitiveness without engaging in big technological modernization programmes or making heavy capital investments. The management operates austere and labour costs are only 10% of total costs—similar to the level of the competing foreign firms—thus giving it a good capacity to respond to external competition.

Its survival has also been helped by a third factor which we may call the “distance effect”. As Chile is a small market, relatively far from the big world markets, it enjoys a certain degree of natural protection: transport costs and the difficulty of establishing an efficient after-sales service help to protect local manufacturers from external competition. This was demonstrated in the 1980s, when external competitors withdrew from the local market without bothering much about the maintenance of the products they had already sold in the country. Consumers learned to take this risk into account and therefore attach importance to local producers with a commitment to after-sales technical assistance.

In 1990, the company returned to the idea of building a new plant: a project which had been left aside for 14 years and which might be seen as a major break with the past or a big technical leap forward. In reality it was not so, however. It did involve a significant increase in the installed production capacity, but still within the types of technology and organization of work which had prevailed in the

FIGURE 8

Compañía Tecno Industrial (CTI):
Effects of period of recovery, 1987-1994



past. The new plans did not incorporate the most advanced international practices in its field. Efforts were made to reduce manufacturing times, but without adopting process automation, computerized stock management or computerized transport of parts and components in the plant.

The situation of macroeconomic stability encouraged the company to finally implement this investment programme which it had not managed to carry out for almost two decades. In doing so, however, it did not construct a completely new factory but simply modernized the existing installations.

The incorporation of modern machinery and automated sub-processes alongside the continued use of old machinery and dies made it possible to improve productivity, achieved economies of scale, and attained greater operational flexibility for small amounts of physical investment. These objectives were undoubtedly achieved, however, at the cost of not carrying out a complete modernization programme which would place the company on an equal technical footing with factories using world-level state-of-the-art practices in this field. Thus, in view of the constant bottlenecks in the painting area—the most recently modernized sub-process in the factory—the company began to consider the possibility of completely doing away with the process of painting the refrigerator bodies which it manufactured and replacing it with a manufacturing technique based on the purchase of pre-painted metal sheet, which is the most modern practice in this field. It is noteworthy that almost two decades after the initiation of the economic openness and trade liberalization process,

TABLE 2

Changes in macroeconomic policies and in the behaviour of industry in general and the Compañía Tecno Industrial (CTI) in particular

Nationwide		In industry in general	In the CTI	
Policies	Reforms	Strategies	Production	Organization and processes
1974-1981				
(1974-1978) Strict control of government spending	Liberalization of goods and capital markets	Rationalization	Reduction in range of products	Reduction of degree of vertical integration and organization of mergers to face changes
Exchange rate unification	Reforms in the areas of taxation, public administration, public enterprises, labour legislation and social security	Restructuring	Purchase of licences	Changes in processes
Active monetary policy (1979-1981) Fixed exchange rate and passive monetary policy		Improvement of quality	Projects for reducing costs	Reorganization to cope with growth requirements
		Changes in financial position		Change of ownership
		Greater importance of exports and imports		Initiation of investment projects
1982-1986				
Abandonment of fixed exchange rate	Tax reform	Outward orientation	End of imports	Reversal of the organizational changes made in the previous period
De-indexing of wages	Reduction in openness of the economy	Creation of new products	Efforts to reduce costs	Efforts to reduce costs
Policies to activate the economy	Intervention in (agricultural) prices	Reduction of manufacturing and organizational costs	Creation of new products and improvement of quality and processes	Reduction of labour force
Policies to reduce fiscal expenditure	New privatization operations		End of investments	Return to labour-intensive in-house processes
Fine-tuning	State intervention of banks		Exports	Return to batch production
1987-1994				
Increase, but subsequently strict control, of the money supply	New trade openness process	New investments	Reduction in range of products	Structural reorganization
Reduction but later increase in VAT	New laws governing the Central Bank and CORFO, and changes in labour legislation	More flexible organizational structures	End of exports	Construction of new plant
Management of interest rates	Tax reform	Product differentiation and improvements in quality	Adoption of CAD system	Reduction in labour force
	Adoption of a basket of foreign currencies	Increase in factor productivity		Partial renewal of machinery
	Greater liberalization of the capital market			Efforts to introduce production-line methods

the company is still far behind the international state-of-the-art.

This leads us to doubt the validity of simplistic ideas which associate economic openness and de-regulation with the closure of inefficient plants, investments in new manufacturing plants, and rapid proximity to international technological levels. These transitions seem to take much longer than is supposed in conventional economic analyses.

Table 2 seeks to sum up this complex set of mutual relations between macroeconomic and microeconomic factors. The first two columns show the three stages into which the Chilean economic history of recent decades may be divided for analytical purposes and reflect the changes in the system of incentives and the regulatory framework which the government authorities made in each of the stages.

These measures brought about changes in business strategies, whose nature is examined in the other three columns.

So far, comparative static analysis has been used to try to understand the behaviour of the firm. It is clear, however, that this theoretical tool is not sufficient for gaining a fuller understanding of the dynamic evolution of the firm. We therefore need another methodology which will enable us to determine more precisely the way in which the technological capacity of the company has evolved.

The technological capacity of a firm may seem to be an abstract concept which is difficult to define, but as Lundvall (1994) notes, it basically involves the capacity to know what to do, how to do it, when to do it, and with whom to do it, at each moment in time. In addition, it involves the development of in-

creasing technological skills in product design, process engineering, organizational technology and production methods.

In line with this approach, we will assume that every firm tries to make improvements in its operating routines. For this purpose, it identifies the weak points in its everyday operations and designs corrective measures to solve these problems. In order to do this, it brings in new equipment and makes changes in organization and methods of work. The company may have its own technical departments responsible for improving product design, methods of work or other aspects, or, if it does not have such formal departments, it may locate these functions outside the company by acquiring services from third parties. At the present time, CTI externally subcontracts product design engineering services, for example.

This cumulative process of development of the technological capacity of the firm is influenced both by internal and external signals. The perception that something could be done better, and the views of the owners and directors of the firm on its long-term objectives, are among the internal factors conditioning the search for new technological know-how. The external factors, for their part, stem from the interaction of the firm with its environment, represented, among other things, by suppliers, clients and trade fairs.

It is important not only to learn by doing, as described by K. Arrow in 1962, but also to learn by interacting, as recently described by B. Lundvall. The firm's capacity to correctly interpret the information received from technical reviews, congresses and international fairs is of crucial importance in this respect.

In order to describe more accurately the CTI's behaviour as regards innovation, we shall now deal with the factors which facilitate or hinder these learning processes.

3. Towards a neo-Schumpeterian interpretation of the CTI's innovation process

a) *The agents or factors responsible for changes in the operating routines of this firm*

Changes in consumer preferences, the appearance of more attractive replacement products on the market, changes in the long-term "visions" and strategies of the owners of the firm, and changes in the macroeconomic incentives to which it must adapt itself are the most obvious source of signals giving rise to changes in the technological conduct of this

company. These changes are expressed through internal activities of the company aimed at modifying its operating routines, or through its links with suppliers, licensees, vendors of machinery and other people with whom it works. In each of these links, processes of interaction may be identified which involve various forms of learning and accumulation of experience.

The firm does not generally sign long-term contracts with its materials suppliers. The latter seem to be able to plan their deliveries sufficiently in advance, however, because of the CTI's stable pattern of purchases. Consequently, the firm has been able to increase its demands in terms of quality and delivery dates, thus improving its own level of internal efficiency. The relations between the CTI and its suppliers in terms of the exchange of technology have been very much influenced by the size and technical capacity of the latter, so that the two-way flow of know-how has been greater with the big suppliers. In the case of the smaller suppliers, in contrast, they have been provided with information and even sometimes equipment, but there does not seem to have been any technological feedback from them.

Another way of incorporating know-how and technology is through the purchase of machinery. In recent years, the prime objective of the firm has been to expand its production capacity. The new machinery it has acquired has been in line with the most advanced international standards. These machines not only mean new equipment on the production line but also make it necessary to generate new technical know-how about organization and methods of work, in order to facilitate their integration into the physical installations of the plant. This incorporation calls for the constant rethinking of the organization of work and production processes in the factory.

The relations which have been established with the suppliers of some inputs make it possible to obtain more information on the type of machines required by the firm, while at the same time improving efficiency in the purchase of inputs. Moreover, the machines are acquired in countries which are on the leading edge of international technology. Seventy per cent of the inputs are imported, which highlights the great importance for CTI of the links with its international suppliers of inputs and machinery.

With regard to distributors, CTI has not tried to develop its own marketing network; it has left the task of gathering know-how in this field to distributing enterprises and big marketing chains such as Falabella, Almacenes París, etc. When these firms try

to obtain discounts and preferential purchase conditions because of the size of their orders, the resulting business relationship is not devoid of tensions. Not much technical feedback is obtained from these links with the distributing chains.

There is another means of establishing direct relations with consumers and obtaining technological information which will allow the firm to guide the generation of new technical know-how, namely, the after-sales service network, which is an important source of information on faulty parts, operating systems which give rise to repeated difficulties in their use, etc. In this respect, the firm has developed a decentralized strategy by creating a subsidiary (CST) responsible for training small concessionaire firms to service the equipment sold. The CTI gives these subcontractors training and the same time tries to stop them providing maintenance services for other brands.

A final point to be noted is that there is little communication with the other local refrigerator manufacturers. Apparently these do not maintain contacts with each other either and do not interact in trade or business associations designed to further the common interests of the sector. This hinders the mutual exchange of technical information, which has become quite important in other fields of industrial activity.

b) *The human teams responsible for changes in the CTI's operating routines*

During the 1970s and 1980s, there were no significant changes in the CTI's organizational chart. The establishment in 1989 of the Department of Engineering and Development and the Department of Production marked the beginning of a new attitude to the generation and use of technical know-how. Subsequently, in 1993, these departments were changed into the Refrigerator and Cooker Division and the Washing Machine and Heater Division, while the strategy of the firm was oriented more towards process engineering than towards product design. In 1994, the Quality Control Division was set up in order to centralize the generation of databases and the follow-up of technical improvements. The other divisions of the firm—Marketing, Administration and Finance—have existed for a long time and built up extensive experience in their respective fields of action.

One of the areas which has been least developed is that concerning the training of human resources.

There is a vertical-type relation between the factory hands and the engineers and technicians, with a supervisor acting as intermediary. Little or nothing has been done in the firm to develop the possibility of collecting technical suggestions from the shop floor up, thus losing part of the process of feedback and learning.

Engineers and technicians are important vehicles for the development and introduction of new technical know-how. It is they who put the new routines into effect and develop engineering improvements which can make processes cheaper and raise quality, with the support of laboratories. If we look at the recent history of the firm, we see that there has indeed been a change in its technology strategy in recent years. The professionals engaged in process engineering have increased significantly, in conjunction with the opening of the new factory. In contrast, however, the technicians and professionals working on product design have lost ground, and the firm has decided to subcontract these activities out to third parties.

c) *External sources facilitating the technological learning process*

An important supplier of technical know-how is Ariston, an Italian firm which produces refrigerators and other domestic electrical appliances. The different conditions of the two countries with regard to markets and technological training, however, have often obliged the Chilean engineers to discard part of the technical information received from the Italian firm. This became clearly evident in connection with the design of the new plant recently brought into production.

The suppliers of equipment generally provide training along with the installation and commissioning of new machinery. Little on-the-job training is given, and there do not seem to be any stable arrangements in Chile for the transfer of technical know-how to the firm from technology institutes or industrial extension agents in the public technological innovation system.

In the opinion of the workers, they are capable of coping with the changes in product design and manufacturing processes which have been introduced, because the tasks are relatively simple and the new techniques do not involve very complex operations. Most of the technological training given in the firm is concentrated on its technicians and engineers.

In recent years, higher standards have been demanded in the hiring of new workers, basically in terms of formal education. Although this has made it more difficult to find suitable factory workers, these difficulties seem to be outweighed by the benefits because of the higher learning capacity of the new workers.

The company seems to have made very little use of the public training system (SENCE). Nor has it used the financing available in connection with programmes carried on by FONTEC, CORFO or other agencies of the country's technological innovation system.

The CTI has not constructed a stable and well-developed system of innovation within the firm, nor has it devoted a significant amount of resources to this purpose. Because of its vertical-type labour relations and the fact that it has made little attempt to

train its workers, there is little feedback from the shop floor up in terms of the generation and dissemination of new technical know-how, and the accumulation of technical capacity is fundamentally in the hands of the company's professionals. The company has never really managed to establish a climate of co-operation with its factory hands.

In recent years, the firm has begun to work more vigorously on its internationalization project, with a view to its future participation in MERCOSUR, and within this context it has begun to attach more importance to technological matters. In the light of past events, it is clear that the firm must make significant investments both in equipment and in the training of human resources if it wishes to expand to outside markets from a solid internal base which will enable it to keep its leading technological position as an economic group with international projections.

V

Conclusions

The foregoing allows us to gain a better understanding of the slow process of transformation of a Chilean metal products and machinery firm and its adaptation to the changing system of macroeconomic incentives which arose after the opening up and deregulation of the country's economy. We have seen how the firm has managed to survive in a highly competitive context, not only because of the existence of market flaws but also because of its own capacity to generate a relatively protected niche thanks to its brand names, the prestige of the firm, and its satisfactory after-sales service. Among the firms which arose in the period when industrialization was protected by tariff barriers, several disappeared during the process of opening up of the Chilean economy because, unlike the CTI, they were not able to successfully overcome the hurdles of adapting to a new system of macroeconomic incentives.

We have shown in this article that the behaviour of this firm fairly accurately reflects the general functioning of the Chilean metal products and machinery sector. The analysis has been supplemented with a systemic view of the technological learning process,

using techniques taken from conventional static comparison and price theory.

We have also tried to link the macroeconomic and microeconomic dimensions, seeking to shed light on the complex mutual relations between these two spheres of economic analysis. The results of the study indicate that the macroeconomic disturbances and the new regulatory and institutional context of the 1970s changed the long-term strategy of the CTI and the way it tackled growth issues.

It has also been confirmed that the transition to a new pattern of behaviour after the opening up and deregulation of the economy is a slow and complex process which cannot be considered as fully completed even now, almost two decades after the structural reform efforts were begun.

We have seen that even today the CTI is a complex mosaic of islands of modernity side by side with areas of technological backwardness, and that it was only very recently that it began to take into account the most modern technologies in its field of operations, with a view to its long-term strategy. It is still not a company of international scale, either in terms of physical investments or of development of its own

technological capacity. It has a long way to go before it can reach this position.

Efforts at internationalization have recently been begun, in the light of the signals coming from MERCOSUR, and these have brought with them new demands in terms of technology and organization that the firm must deal with gradually. The develop-

ment of in-house technological capacity and physical investments in new production facilities must be carried out side by side with the process of moving up to a scale of operations much higher than that reached so far.

(Original: Spanish)

Bibliography

- Agacino, R., G. Rivas and E. Román (1992): *Apertura y eficiencia productiva: la experiencia chilena 1975-1989*, Documento de trabajo No. 92, Santiago, Chile, Programme on the Economics of Labour (PET).
- Castillo, M., C. Maggi and M. Dini (1994): *Reorganización industrial y estrategias competitivas en Chile*, LC/R.1467, Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC), Joint ECLAC/UNIDO Industrial and Technological Development Unit.
- Corbo, V. and J.M. Sánchez (1992): El ajuste de las empresas del sector industrial en Chile durante 1974-1982, *Colección estudios CIEPLAN*, No. 35, Santiago, Chile, Economic Research Corporation for Latin America (CIEPLAN).
- ECLAC/IDRC (International Development Research Centre) (1995): *La industria chilena entre 1970-1994: de la sustitución de importaciones a la segunda fase exportadora*, LC/R.1535, Santiago, Chile.
- INE (National Institute of Statistics) (several years): *Anuario estadístico*, Santiago, Chile.
- Lundvall, B. (1994): *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, London, Pinter.
- Marshall, I. (1992): Liberalización comercial en Chile y su impacto sobre la eficiencia técnica industrial: 1974-1986, *Colección estudios CIEPLAN*, No. 35, Santiago, Chile, CIEPLAN.
- Mizala, A. (1992): Las reformas económicas de los años setenta y la industria manufacturera chilena, *Colección estudios CIEPLAN*, No. 35, Santiago, Chile, CIEPLAN.
- Meller, P. (1992): La apertura comercial chilena: lecciones de política, *Colección estudios CIEPLAN*, No. 35, Santiago, Chile, CIEPLAN.
- Rosenberg, N. (1976): *Perspectives on Technology*, Cambridge, U. K., Cambridge University Press.